Operating Instructions

Diesel engine
20 V 4000 G23 with 6 exhaust turbochargers
20 V 4000 G43 with 6 exhaust turbochargers
20 V 4000 G63 with 6 exhaust turbochargers
20 V 4000 G63L with 6 exhaust turbochargers
20 V 4000 G83 with 6 exhaust turbochargers
20 V 4000 G83L with 6 exhaust turbochargers

MS150093/01E

Power. Passion. Partnership.

Printed in Germany

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This handbook is provided for use by maintenance and operating personnel in order to avoid malfunctions or damage during operation.

Subject to alterations and amendments.

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1 Safety

1.1 General conditions

General

In addition to the instructions in this publication, the applicable country-specific legislation and other compulsory regulations regarding accident prevention and environmental protection must be observed. This state-of-the-art engine has been designed to meet all applicable laws and regulations. The engine may nevertheless present a risk of injury or damage in the following cases:

- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Noncompliance with the Safety Instructions

Correct use

The engine is intended solely for use in accordance with contractual agreements and the purpose envisaged for it on delivery. Any other use is considered improper use. The engine manufacturer accepts no liability whatsoever for resultant damage or injury in such case. The responsibility is borne by the user alone.

Correct use also includes observation of and compliance with the maintenance specifications.

Modifications or conversions

Unauthorized modifications to the engine represent a safety risk.

MTU will accept no liability or warranty claims for any damage caused by unauthorized modifications or conversions.

Spare parts

Only genuine MTU spare parts must be used to replace components or assemblies. MTU accepts no liability whatsoever for damage or injury resulting from the use of other spare parts and the warranty shall be voided in such case.

Reworking components

Repair or engine overhaul must be carried out in workshops authorized by MTU.

TIM-ID: 0000000860 - 017

1.2 Personnel and organizational requirements

Personnel requirements

All work on the engine shall be carried out by trained and qualified personnel only.

The specified legal minimum age must be observed.

The operator must specify the responsibilities of the operating, maintenance and repair personnel.

Organizational measures

This publication must be issued to all personnel involved in operation, maintenance, repair or transportation.

Keep it at hand at the operating site of the engine so that it is available to operating, maintenance, repair and transport personnel at all times.

Use the manual as a basis for instructing personnel on engine operation and repair with an emphasis on explaining safety-relevant instructions.

This is particularly important in the case of personnel who only occasionally perform work on or around the engine. This personnel must be instructed repeatedly.

For the identification and layout of the spare parts during maintenance or repair work, take photos or use the spare parts catalog.

Working clothes and protective equipment

Wear proper protective clothing for all work.

Use the necessary protective equipment for the given work to be done.

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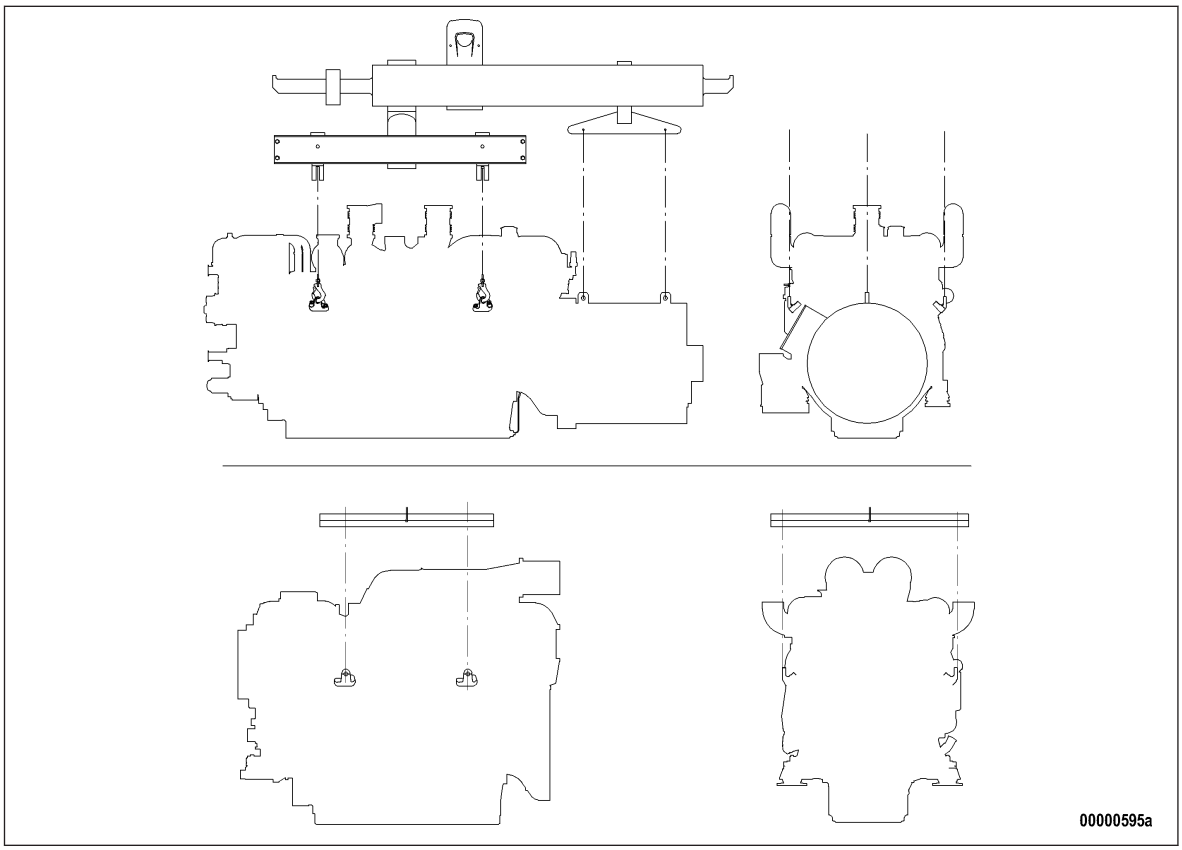
1.3 Transport

Transport



Always use the lifting eyes on the engine and generator/gearbox when transporting gensets.

Always use the lifting eyes on the engine when transporting an engine separately.

Only use transport and lifting devices approved by MTU.

The engine/genset must only be transported in installation position: maximum permissible diagonal pull 10°.

Remove any loose parts on the genset.

Raise the engine/genset slowly. The lifting ropes or chains must not make contact with the engine or its components. Readjust lifting device as necessary.

Pay attention to the center of gravity of the engine/genset.

For special packaging with aluminium foil: Suspend the engine/genset by the lifting eyes on the bearing pedestal or transport by means of handling equipment (forklift truck) capable of bearing the load.

Fit the crankshaft transportation lock on the engine and fit the engine mount locking devices prior to transport.

Secure the engine/genset such as to preclude tipping during transport. Secure such as to preclude slipping and tipping when driving up or down inclines and ramps.

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Placement after transport

Place the engine/genset on a firm, flat surface only.

Make sure that the consistency and load-bearing capacity of the ground or support surface is adequate.

Never set an engine down on the oil pan unless expressively authorized to do so by MTU on a case-to-case basis.

1.4 Crankshaft transport locking device

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10-60 Nm	F30510423	1
Torque wrench, 60-320 Nm	F30047446	1
Engine oil		

Transport locking device

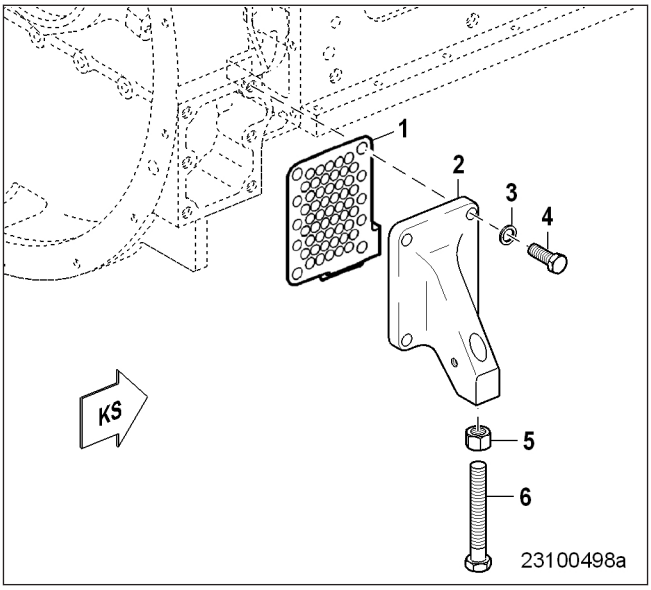
Note: The locking device protects the crankshaft bearings from shocks and vibration damage during engine transport.

For installation and removal of the transport locking device, follow the instructions below:

1. The transport locking device must remain installed as long as possible during engine installation in order to avoid damage.
2. Prior to every engine transport, the transport locking device must be reinstalled on both sides according to the instructions.
3. If the engine is to be moved together with the generator, the transport locking device for the generator must also be installed.
4. Always use the screws supplied with or installed in the transport locking device to secure it on the engine.
5. Starting or barring the engine is allowed only with the transport locking device removed. If the generator is already mounted on the engine, ensure that the transport locking device of the generator is also removed.
6. Attach these instructions, clearly visible, to the engine.

Removing guard plates and engine mounting brackets (if applicable) on driving end (KS)

1. Remove screws (4) om both sides and take off with washers (3), guard plates (1) and engine mounting brackets (2).
2. Store the removed parts of the transport locking device carefully for possible reuse.



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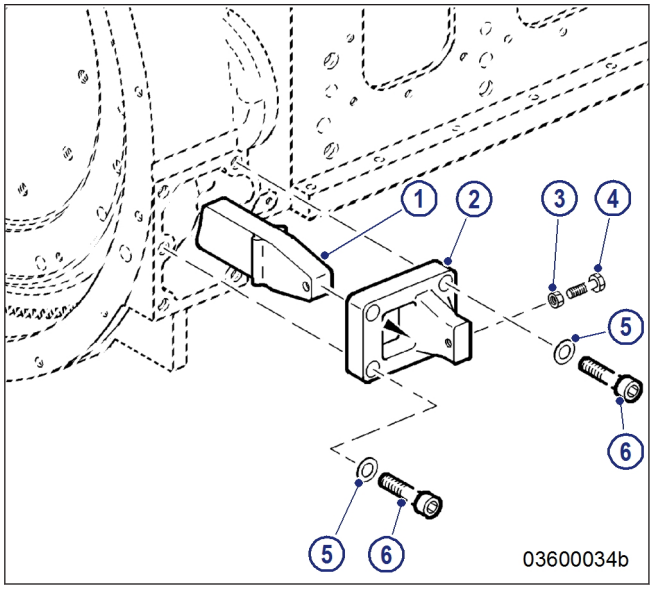
Fitting the transport locking device on driving end (KS)



Note: Attach plates (2) only to the upper part of the openings.

1. Secure the two plates (2) with screws (6) and washers (5) at the bores on both sides of the flywheel housing and tighten to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M16	Tightening torque	(Engine oil)	250 Nm +25 Nm

2. Screw nut (3) onto screws (4) up to the end of the thread.
3. The long end of retainers (1) must face downwards. Push retainers (1) with the round front face through the plate openings (2).

Note: The retainers (1) must lock the flywheel only, not the ring gear.

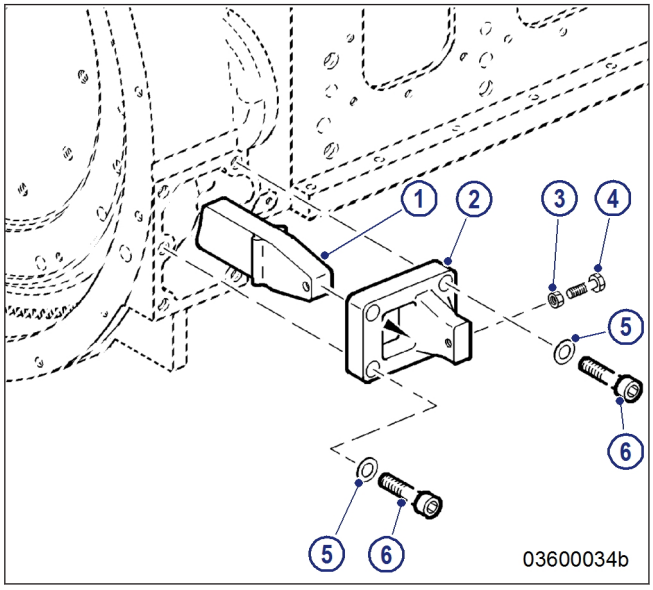
4. Install screws (4) into the bores of retainers (1) until the retainers (1) are locked in position.
5. Tighten screws (4) alternately with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M10	Tightening torque	(Engine oil)	30 Nm +3 Nm

6. Screw on nuts (3) of both screws (4) at plates (2) and secure.

Removing the transport locking device from driving end (KS)

1. Release the locknuts (3) on both sides of the flywheel housing, remove screws (4) and take off the two locks (1).
2. Unscrew screws (6) and remove together with washers (5) and plates (2).
3. Store the removed parts of the transport locking device together with this documentation carefully for possible reuse.



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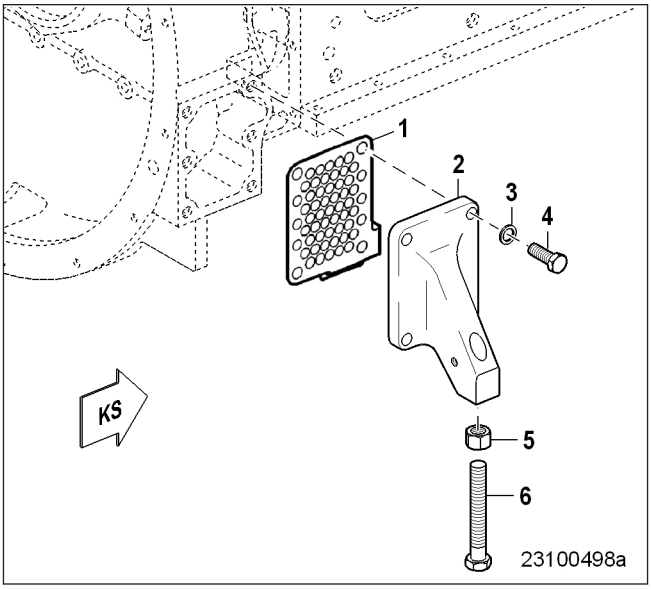
Installing guard plates and engine mounting brackets (if applicable) on driving end (KS)

Note: Always use the screws supplied with the or removed from the guard plates and engine mounting brackets to secure them on the engine.

1. Install engine mounting brackets (2) on both sides with guard plates (1) washers (3), and screws (4).
2. Tighten screws (4).



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1.5 Explosion hazard when removing inspection port cover on engine

DANGER

Explosion hazard due to oil vapors.
Risk of serious injury – danger to life!
- Allow the engine to cool down before opening the crankcase!
- Avoid open flames, electrical sparks and ignition sources.

Safety instructions

▶ Before starting maintenance work, allow the engine to cool down for at least 10 min. (danger of explosion due to oil vapors).

TIM-ID: 0000022931 - 006

1.6 Safety regulations for maintenance and repair work

Safety regulations for maintenance and repair work

Have maintenance and repair work carried out by qualified and authorized personnel only.

Allow the engine to cool down before starting maintenance work (risk of explosion of oil vapors).

Before starting work, relieve pressure in systems and compressed-air lines which are to be opened.

Take special care when removing ventilation or plug screws from the engine. Cover the screw or plug with a rag to prevent fluids escaping under pressure.

Take special care when draining hot fluids ⇒ Risk of injury.

When changing the engine oil or working on the fuel system, ensure that the engine room is adequately ventilated.

Allow the engine / system to cool down before starting to work.

Observe the maintenance and repair instructions.

Never carry out maintenance and repair work with the engine running unless expressly instructed to do so.

Secure the engine against accidental starting.

Disconnect the battery when electrical starters are fitted.

Close the main valve on the compressed-air system and vent the compressed-air line when pneumatic starters are fitted.

Disconnect the control equipment from the assembly or system.

Use only proper, calibrated tools. Observe the specified tightening torques during assembly/disassembly.

Carry out work only on assembles and/or units which are properly secured.

Never use lines for climbing.

Keep fuel injection lines and connections clean.

Always seal connections with caps or covers if a line is removed or opened.

Take care not to damage lines, in particular fuel lines, during maintenance and repair work.

Ensure that all retainers and dampers are installed correctly.

Ensure that all fuel injection and pressurized oil lines are installed with enough clearance to prevent contact with other components. Do not place fuel or oil lines near hot components.

Do not touch elastomeric seals if they have carbonized or resinous appearance unless hands are properly protected.

Note cooling time for components which are heated for installation or removal ⇒ Risk of burning.

When working high on the engine, always use suitable ladders and work platforms. Make sure components are placed on stable surfaces.

Observe special cleanness when conducting maintenance and repair work on the assembly or system. After completion of maintenance and repair work, make sure that no loose objects are in/on the assembly or system.

Before barring the engine, make sure that nobody is standing in the danger zone. Check that all guards have been reinstalled and that all tools and loose parts have been removed after working on the engine.

The following additional instructions apply to starters with beryllium copper pinion:

- Breathing protection of filter class P2 must be applied during maintenance work to avoid health hazards caused by the beryllium-containing pinion. Do not blow out the interior of the flywheel housing or the starter with compressed air. Clean the flywheel housing inside with a class H dust extraction device as an additional measure.

TIM-ID: 0000000879 - 023

Welding work

Never carry out welding work on the assembly, system, or engine-mounted units. Cover the engine when welding in its vicinity.

Do not use the assembly or system as ground terminal.

Do not route the welding lead over or near the wiring harnesses of MTU systems. The welding current may otherwise induce an interference voltage in the wiring harnesses which could conceivably damage the electrical system.

Remove parts (e.g. exhaust pipes) which are to be welded from the engine beforehand.

Hydraulic installation and removal

Check the function and safe operating condition of tools and fixtures to be used. Use only the specified devices for hydraulic removal/installation procedures.

Observe the max. permissible push-on pressure specified for the equipment.

Do not attempt to bend or apply force to lines.

Before starting work, pay attention to the following:
- Vent the hydraulic installation/removal tool, the pumps and the lines at the relevant points for the equipment to be used (e.g. open vent plugs, pump until bubble-free air emerges, close vent plugs).
- For hydraulic installation, screw on the tool with the piston retracted.
- For hydraulic removal, screw on the tool with the piston extended.

For a hydraulic installation/removal tool with central expansion pressure supply, screw spindle into shaft end until correct sealing is established.

During hydraulic installation and removal, ensure that nobody is standing in the immediate vicinity of the component to be installed/removed.

Working on electrical/electronic assemblies

Always obtain the permission of the person in charge before commencing maintenance and repair work or switching off any part of the electronic system required to do so.

De-energize the appropriate areas prior to working on assemblies.

Do not damage cabling during removal work. When reinstalling ensure that wiring is not damaged during operation by contact with sharp objects, by rubbing against other components or by a hot surface.

Do not secure cables on lines carrying fluids.

Do not use cable binders to secure cables.

Always use connector pliers to tighten connectors.

Subject the device or system to a function check on completion of all repair work.

Store spare parts properly prior to replacement, i.e. protect them against moisture in particular. Pack defective electronic components and assemblies in a suitable manner when dispatched for repair, i.e. particularly protected against moisture and impact and wrapped in antistatic foil if necessary.

Working with laser equipment

When working with laser equipment, always wear special laser-protection goggles ⇒ Heavily focused radiation.

Laser equipment must be fitted with the protective devices necessary for safe operation according to type and application.

TIM-ID: 0000000879 - 023

For conducting light-beam procedures and measurement work, only the following laser devices must be used:

- Laser devices of classes 1, 2 or 3A.
- Laser devices of class 3B, which have maximum output in the visible wavelength range (400 to 700 nm), a maximum output of 5 mW, and in which the beam axis and surface are designed to prevent any risk to the eyes.

TIM-ID: 000000879 - 023

1.7 Auxiliary materials, fluids and lubricants, fire prevention and environmental protection

Fire prevention

Rectify any fuel or oil leaks immediately; even splashes of oil or fuel on hot components can cause fires – therefore always keep the engine in a clean condition. Do not leave cloths soaked with fluids and lubricants lying on or near the assembly or unit. Do not store inflammable material near the assembly or unit.

Do not weld pipes and components carrying oil or fuel! Before welding, clean with a nonflammable fluid.

When starting the engine with an external power source, connect the ground lead last and remove it first. To avoid sparks in the vicinity of the battery, connect the ground lead from the external power source to the ground lead of the engine or to the ground terminal of the starter.

Always keep suitable firefighting equipment (fire extinguishers) at hand and familiarize yourself with their use.

Noise

Noise can lead to an increased risk of accident if acoustic signals, warning shouts or noises indicating danger are drowned.

Wear ear protectors in work areas with a sound pressure level in excess of 85 dB (A).

Environmental protection and disposal

Modification or removal of mechanical or electronic components or the installation of additional components as well as the execution of calibration processes that might affect the emission characteristics of the engine are prohibited by emission regulations. Emission control units/systems may only be maintained, exchanged or repaired if the components used for this purpose are approved by MTU or equivalent components. Noncompliance with these guidelines might represent a violation of the Clean Air Act and involves the termination of the operating license by the emission authorities. MTU does not accept any liability for violations of the emission regulations. MTU will provide assistance and advice if emission-relevant components are intended to be modified. The MTU Maintenance Schedules ensure the reliability and performance of MTU engines and must be complied with over the entire life cycle of the engine.

Use only fuel of prescribed quality to comply with emission limit values.

Dispose of used fluids, lubricants and filters in accordance with local regulations.

Within the EU, batteries can be returned free of charge to MTU FN / MTU Onsite Energy where they are subjected to proper recycling procedures.

Auxiliary materials, fluids and lubricants

Use only fluids and lubricants that have been tested and approved by MTU.

The Fluids and Lubricants Specifications will be amended or supplemented as necessary. Before using them, make sure you have the latest version. The latest version is also available at: http://www.mtu-online.com/mtu/mtu-valuecare/mtu-valueservice-Technische-Dokumentation.

Keep fluids and lubricants in suitable, properly designated containers. When using fluids, lubricants and other chemical substances, follow the safety instructions that apply to the product. Take special care when using hot, chilled or caustic materials. When using flammable materials, avoid all sparks and do not smoke.

Used oil

Used oil contains harmful combustion residues.

Rub barrier cream into hands.

Wash hands after contact with used oil.

TIM-ID: 0000000880 - 016

Lead

- When working with lead or lead-containing compounds, avoid direct contact to the skin and do not inhale lead vapors.
- Adopt suitable measures to avoid the formation of lead dust.
- Switch on extraction system.
- Wash hands after contact with lead or lead-containing substances.

Compressed air

Observe special safety precautions when working with compressed air:

- Pay special attention to the pressure level in the compressed air network and pressure vessel.
- Assemblies and equipment to be connected must either be designed for this pressure, or, if the permitted pressure for the connecting elements is lower than the pressure required, a pressure reducing valve and safety valve (set to permitted pressure) must form an intermediate connection.
- Hose couplings and connections must be securely attached.
- Wear goggles when blowing off components or blowing away chips.
- Provide the snout of the air nozzle with a protective disk (e.g. rubber disk).
- First shut off compressed air lines before compressed air equipment is disconnected from the supply line, or before equipment or tool is to be replaced.
- Unauthorized use of compressed air, e.g. forcing flammable liquids (danger class AI, AII and B) out of containers, results in a risk of explosion.
- Forcing compressed air into thin-walled containers (e.g. containers made of tin, plastic and glass) for drying purposes or to check for leaks, results in a risk of bursting.
- Carry out leak test in accordance with the specifications.

Paints and lacquers

- When carrying out painting work outside the spray stands provided with fume extraction systems, ensure that the area is well ventilated. Make sure that neighboring work areas are not impaired.
- No open flames.
- No smoking.
- Observe fire prevention regulations.
- Always wear a mask providing protection against paint and solvent vapors.

Liquid nitrogen

- Store liquid nitrogen only in small quantities and always in regulation containers without fixed covers.
- Avoid body contact (eyes, hands).
- Wear protective clothing, protective gloves, closed shoes and protective goggles / safety mask.
- Make sure that working area is well ventilated.
- Avoid all knocks and jars to the containers, fixtures or workpieces.

Acids and alkaline solutions

- When working with acids and alkaline solutions, wear protective goggles or face mask, gloves and protective clothing.
- If such solutions are spilled onto clothing, remove the affected clothing immediately.
- Rinse injured parts of the body thoroughly with clean water.
- Rinse eyes immediately with eyedrops or clean tap water.

TIM-ID: 0000000880 - 016

1.8 Conventions for safety instructions in the text

DANGER	In the event of immediate danger. **Consequences: Death or serious injury** • Remedial action
WARNING	In the event of potentially dangerous situations. **Consequences: Death or serious injury** • Remedial action
CAUTION	In the event of dangerous situations. **Consequences: Minor injury or material damage** • Remedial action
NOTICE	In the event of a situation involving potentially adverse effects on the product. **Consequences: Material damage.** • Remedial action • Additional product information

Note: This manual contains highlighted safety warnings in accordance with the US ANSI Z535 standard which begin with one of the signal words listed above depending on the severity of the hazard.

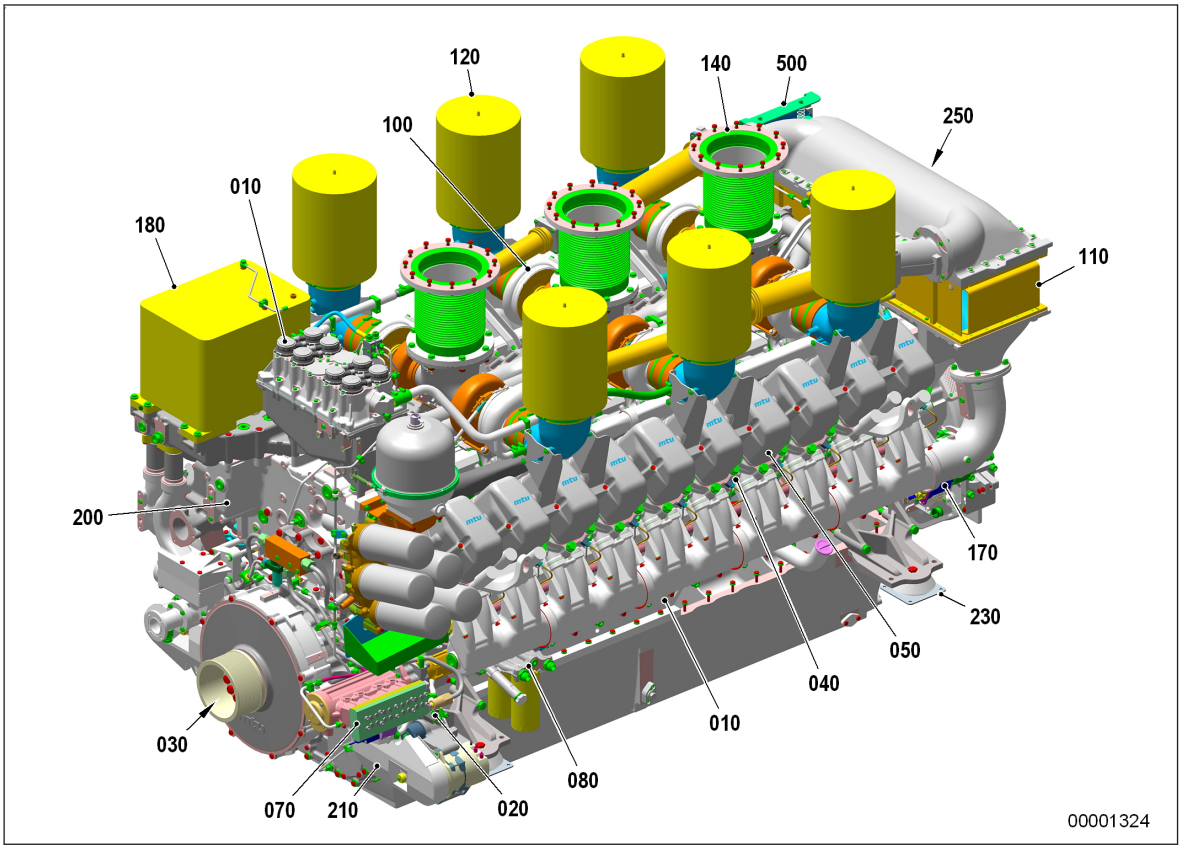
Safety instructions

1. Read and familiarize yourself with all safety notices before starting up or repairing the product.
2. Pass on all safety instructions to your operating, maintenance, repair and transport personnel.

TIM-ID: 0000000881 - 018

2 Product Summary

2.1 Engine Layout



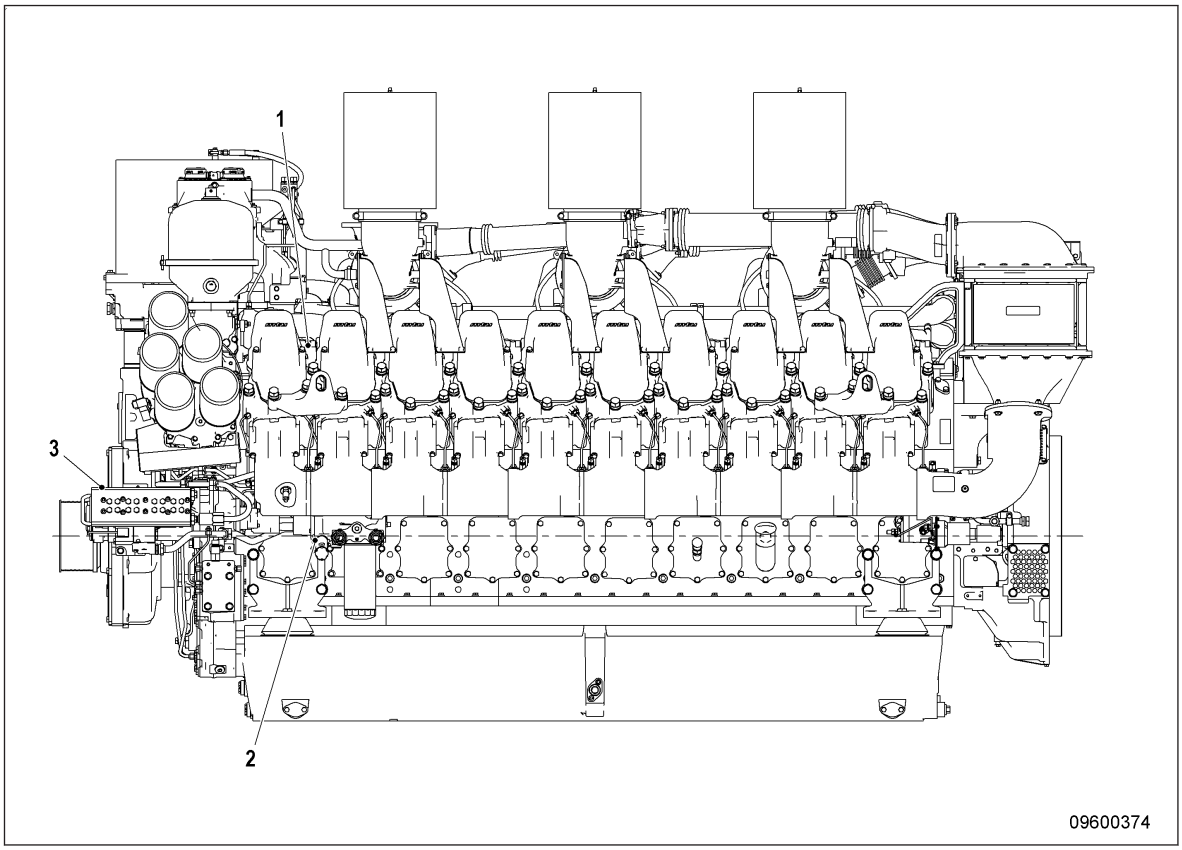
010 Crankcase and add-on components
020 Gear train
030 Running gear
040 Cylinder head
050 Valve gear
070 Fuel system (high pressure)
080 Fuel system (low pressure)
100 Exhaust turbocharger
110 Intercooler
120 Air intake/air supply
140 Exhaust system
170 Starting equipment
180 Lube oil system / lube oil circuit
200 Coolant system
210 Power supply
230 Mounting/support
250 PTO systems, driving end and free end (coupling)
500 Engine governor

Engine type designation

Explanation of engine type designation 20V 4000 Gx3	
20	Number of cylinders
v	Cylinder arrangement: V engine
4000	Series
G	Application
X	Application segment (2, 4, 6, 8)
3	Configuration status

TIM-ID: 0000019853 - 001

2.2 Overview of sensors, actuators and injectors



1 Temperature sensors for single exhaust gas B4.1 to B4.10 (engine side A)

2 Sensor B34 (P-Fuel after filter)

3 M8 (HP fuel pump actuator)

The injectors (Y39.1 to Y39.10, engine side A) are underneath the cylinder head covers of the cylinder. Injector replacement and necessary activities (→ Page 119).

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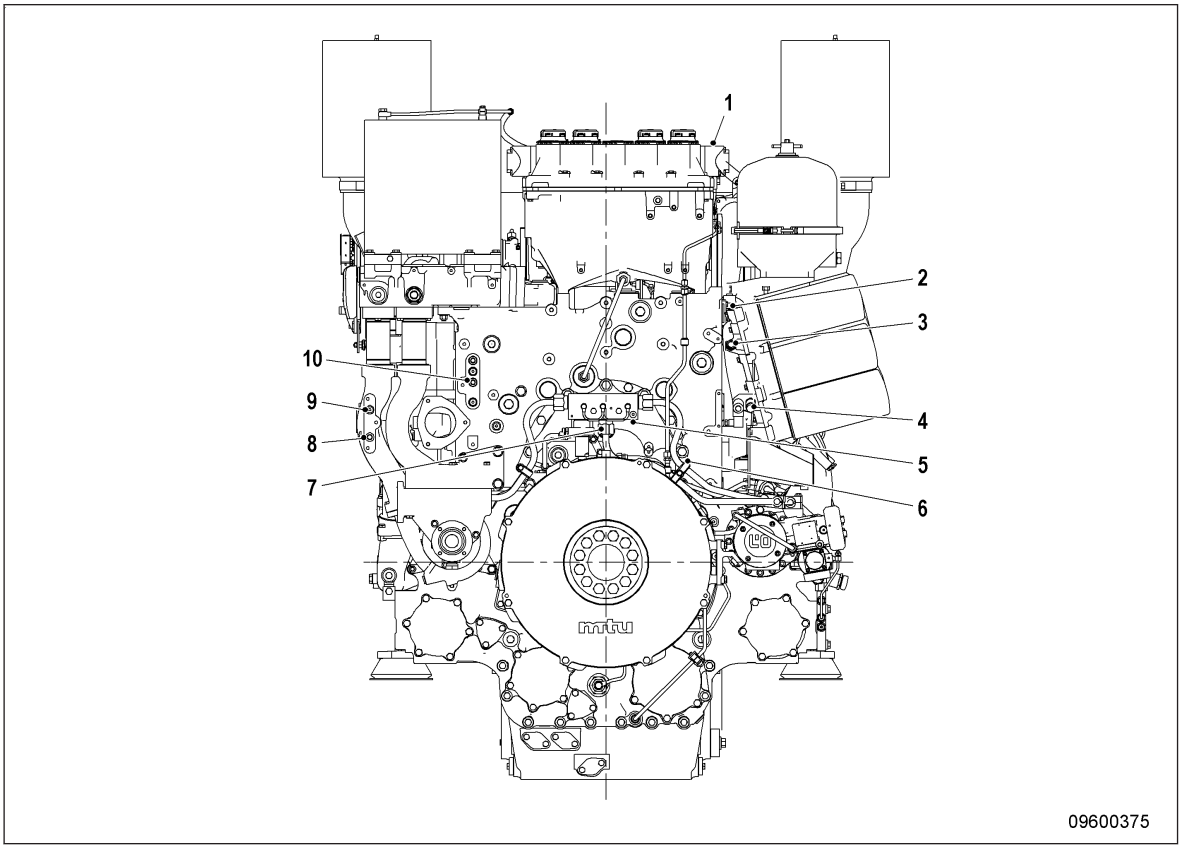
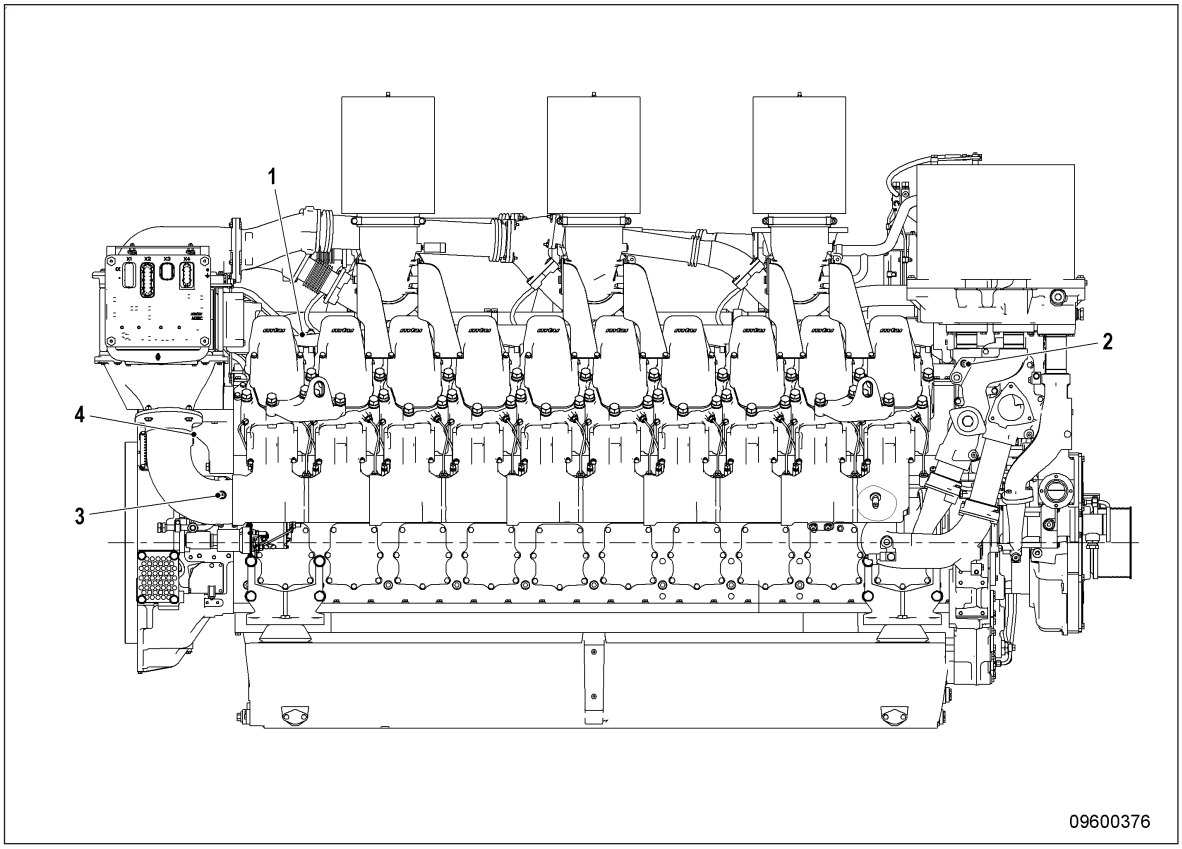


1 B50 (P crankcase)
2 B05.3 (P lube oil before filter)
3 B05 (P lube oil after filter)
4 B33 (T fuel, rail)
5 B07 (T lube oil)
6 B01 (N camshaft)
7 B48 (P fuel, rail)
8 B43 (P charge-air coolant)
9 B26 (T charge-air coolant)
10 B06 (T coolant)

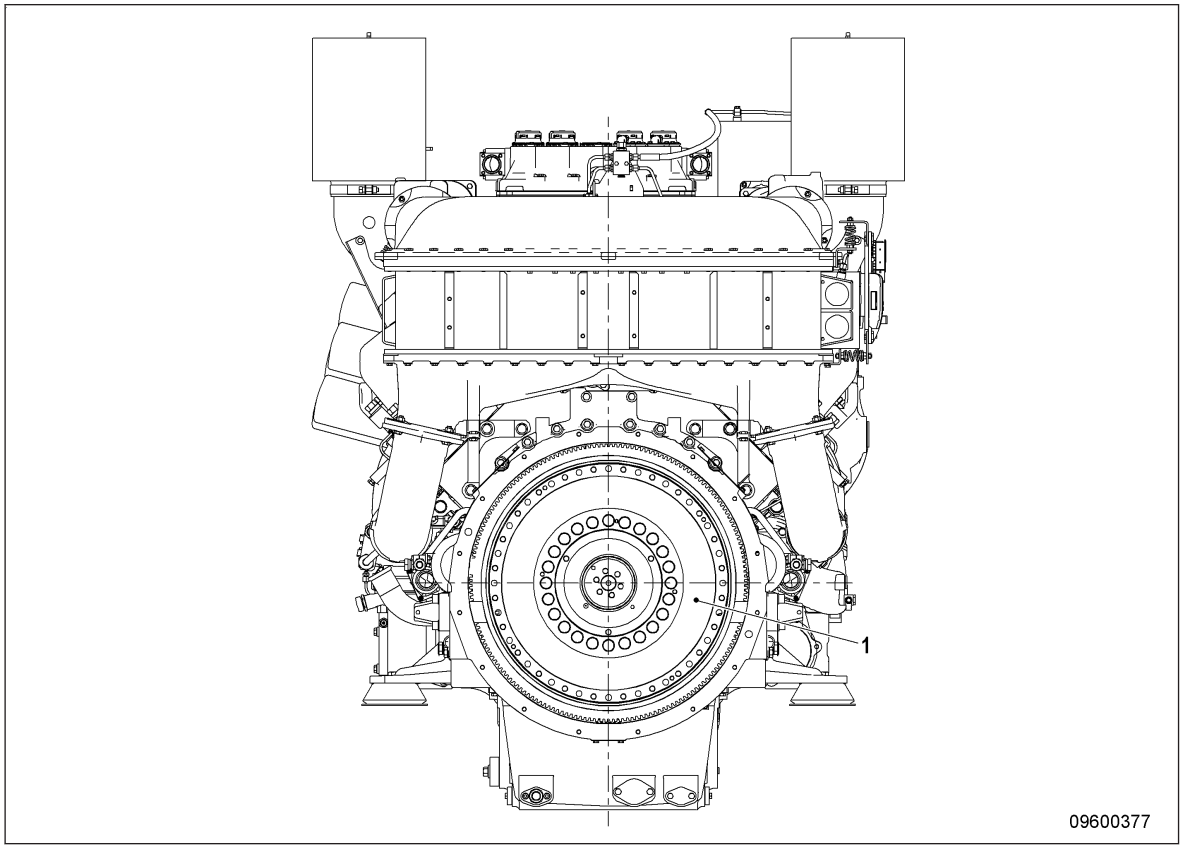
TIM-ID: 0000019859 - 001



1 Temperature sensors for single exhaust gas B4.11 to B4.20 (engine side B)
2 B16 (P coolant)
3 B10 (P charge air)
4 B09 (T charge air)

The injectors (Y39.11 to Y39.20, engine side B) are underneath the cylinder head covers of the cylinder. Injector replacement and required procedure (→ Page 119)

TIM-ID: 0000019859 - 001

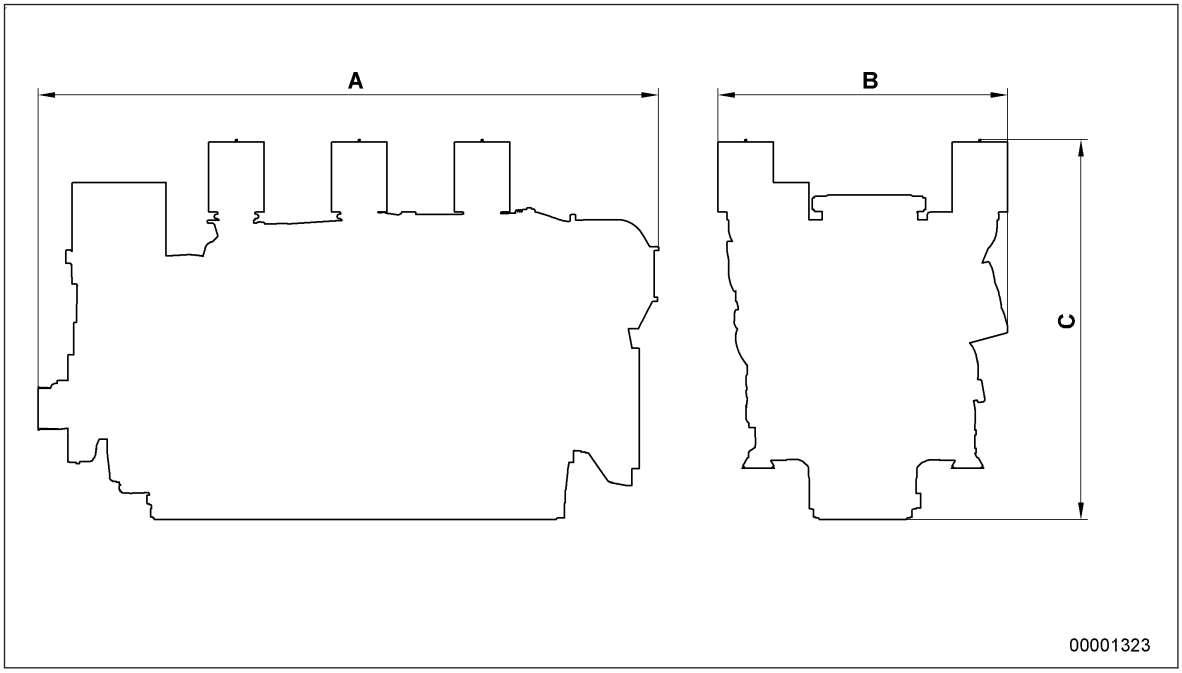


1 B13 (N crankshaft)

TIM-ID: 0000019859 - 001

2.3 Engine – Main dimensions

Engine – Main dimensions



Length (A)	approx. 3560 mm
Width (B)	approx. 1660 mm
Height (C)	approx. 2163 mm

TIM-ID: 0000019845 - 001

2.4 Firing order

Firing order

Number of cylinders	Firing order
8V	A1-B4-A4-A2-B3-A3-B2-B1
12V	A1-B5-A5-B3-A3-B6-A6-B2-A2-B4-A4-B1
16 V	A1-A7-B4-B6-A4-B8-A2-A8-B3-B5-A3-A5-B2-A6-B1-B7
20 V	A1-B5-A8-B7-A5-B2-A7-B10-A2-B3-A10-B6-A3-B4-A6-B9-A4-B1-A9-B8

TIM-ID: 0000002796 - 003

2.5 Final compression pressure

Final compression pressure

Final compression pressure at 120 rpm	24 bar to 28 bar

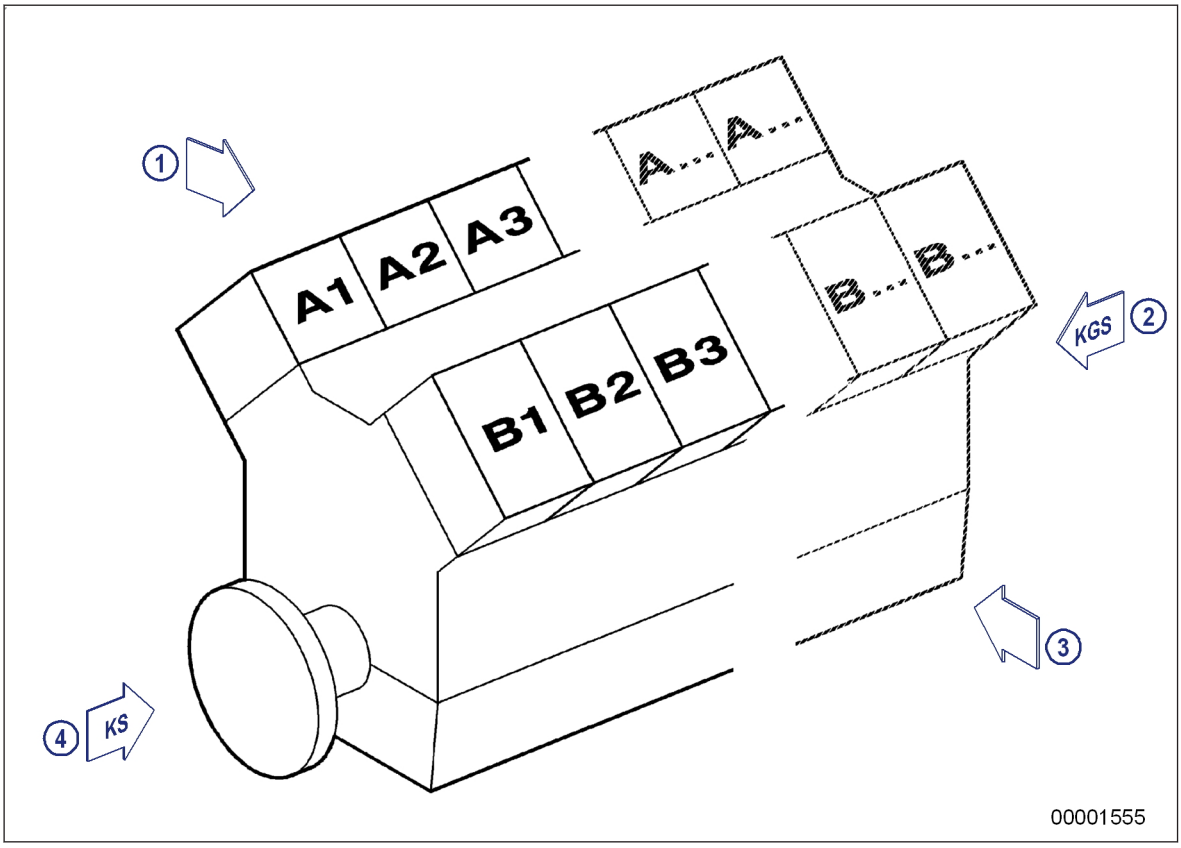
TIM-ID: 0000002820 - 001

2.6 Engine side and cylinder designations

Engine sides are always designated as viewed from the driving end (KS).

The cylinders of the left engine side are designated "A" and those of the right side "B" (as per DIN ISO 1204). The cylinders of each bank are numbered consecutively, starting with No. 1 at the driving end.

Other components are numbered in the same way, i.e. starting with No. 1 on driving end.



1 Left engine side
2 KGS = Free end
3 Right engine side
4 KS = Driving end

TIM-ID: 0000002185 - 010

2.7 20V 4000 Gx3 engine data: Continuous operation, variable 3B, optimized fuel consumption

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated, without change (e.g. of power settings).
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			20V 4000G23	20V 4000G63	20V 4000G63L	20V 4000G83	20V 4000G83L
Application group			3B	3B	3B	3B	3B
Intake air temperature		°C	25	25	25	25	25
Charge-air coolant temperature		°C	55	55	55	55	55
Raw-water inlet temperature		°C	-	-	-	-	-
Barometric pressure		mbar	1000	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100	100

POWER-RELATED DATA (power ratings are net brake power as per ISO 3046)

Number of cylinders			20	20	20	20	20
Rated engine speed	A	rpm	1500	1500	1500	1800	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	2200	2420	2590	2740	3010
Fuel stop power	A	kW	2420	2662	2849	3014	3311

GENERAL CONDITIONS (for maximum power)

Number of cylinders			20	20	20	20	20
Intake depression (new filter)	A	mbar	15	15	15	15	15
Intake depression, max.	L	mbar	50	50	50	50	50

TIM-ID: 0000023524 - 001

Number of cylinders			20	20	20	20	20
Exhaust gas over-pressure			30	30	30	30	30
Exhaust gas over-pressure, max.	A	mbar	85	85	85	85	85

MODEL-RELATED DATA (basic design)

Number of cylin-ders			20	20	20	20	20
Number of cylin-ders			20	20	20	20	20
Cylinder arrange-ment: V-angle		Degrees	90	90	90	90	90
Bore		mm	170	170	170	170	170
Stroke		mm	210	210	210	210	210
Cylinder displace-ment		Liters	4.77	4.77	4.77	4.77	4.77
Total displacement		Liters	95.4	95.4	95.4	95.4	95.4
Compression ratio			16.4	16.4	16.4	16.4	16.4
Inlet valves per cyl-inder			2	2	2	2	2
Exhaust valves per cylinder			2	2	2	2	2

COMBUSTION AIR / EXHAUST GAS

Number of cylin-ders			20	20	20	20	20
Charge air pressure before cylinder, DL	R	bar abs	2.3	2.5	2.8	3.1	3.4

COOLANT SYSTEM (HT circuit)

Number of cylin-ders			20	20	20	20	20
Coolant tempera-ture (at engine con-nection: outlet to cooling system)	A	°C	100	100	100	100	100
Coolant tempera-ture after engine, warning	R	°C	102	102	102	102	102
Coolant tempera-ture after engine, shutdown	L	°C	104	104	104	104	104
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Pressure loss in off-engine cooling sys-tem, max.	L	bar	0.7	0.7	0.7	0.7	0.7

TIM-ID: 0000023524 - 001

COOLANT SYSTEM (LT circuit)

Number of cylinders			20	20	20	20	20
Coolant temperature before intercooler (at engine inlet inlet from cooling system)	A	°C	55	55	55	55	55
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7

LUBE OIL SYSTEM

Number of cylinders			20	20	20	20	20
Lube oil operating temperature before engine, from	R	°C	88	88	88	88	88
Lube oil operating temperature before engine, to	R	°C	98	98	98	98	98
Lube oil temperature before engine, warning	R	°C	99	99	99	99	99
Lube oil temperature before engine, shutdown	L	°C	101	101	101	101	101
Lube oil operating pressure before engine, from	R	bar	4.6	4.5	4.4	5.0	4.9
Lube oil operating pressure before engine, to	R	bar	7.4	7.3	7.2	7.8	7.7

FUEL SYSTEM

Number of cylinders			20	20	20	20	20
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine (when engine is starting), max.	L	bar	1.5	1.5	1.5	1.5	1.5

TIM-ID: 0000023524 - 001

GENERAL OPERATING DATA

Number of cylinders			20	20	20	20	20
Cold start capability: Air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	10	10	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32	32
Firing speed, from	R	rpm	80	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120	120

CAPACITIES

Number of cylinders			20	20	20	20	20
Engine coolant capacity, engine side (without cooling system)	R	Liters	205	205	205	205	205
Charge-air coolant, engine side	R	Liters	30	30	30	30	30
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	390	390	390	390	390
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	245	245	245	245	245
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	340	340	340	340	340

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			20	20	20	20	20
Engine weight, dry (basic engine configuration acc. to scope of delivery specification)	R	kg	9290	9290	9290	9290	9290

TIM-ID: 0000023524 - 001

ACOUSTICS

Number of cylinders			20	20	20	20	20
Engine surface noise with attenuated intake noise (filter) - DL (free-field sound power level Lp, 1 m distance, ISO 6798, +2dB(A) tolerance)	R	dB(A)	104	104	106	106	110
Engine surface noise with attenuated intake noise (filter) - DL (sound power level LW, ISO 6798, +2dB (A) tolerance)	R	dB(A)	123	123	124	125	130

TIM-ID: 0000023524 - 001

2.8 20V 4000 Gx3 engine data: Continuous operation, variable 3B, optimized exhaust emissions ("TA-Luft")

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
R Guideline value
L Limit value, up to which the engine can be operated, without change (e.g. of power settings).
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			20V 4000G23	20V 4000G63	20V 4000G63 L
Application group			3B	3B	3B
Intake air temperature		°C	25	25	25
Charge-air coolant temperature		°C	55	55	55
Barometric pressure		mbar	1000	1000	1000
Site altitude above sea level		m	100	100	100

POWER-RELATED DATA (power ratings are net brake power as per ISO 3046)

Number of cylinders			20	20	20
Rated engine speed	A	rpm	1500	1500	1500
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	2200	2420	2590
Fuel stop power ISO 3046		kW	2420	2662	2849

GENERAL CONDITIONS (for maximum power)

Number of cylinders			20	20	20
Intake depression (new filter)	A	mbar	15	15	15
Intake depression, max.	L	mbar	50	50	50

MODEL-RELATED DATA (basic design)

Number of cylinders			20	20	20
Number of cylinders			20	20	20
Cylinder arrangement: V-angle		Degrees	90	90	90
Bore		mm	170	170	170
Stroke		mm	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77
Total displacement		Liters	95.4	95.4	95.4

TIM-ID: 0000023556 - 001

Number of cylinders			20	20	20
Compression ratio			16.4	16.4	16.4
Inlet valves per cylinder			2	2	2
Exhaust valves per cylinder			2	2	2

COMBUSTION AIR / EXHAUST GAS

Number of cylinders			20	20	20
Charge air pressure before cylinder, DL	R	bar abs	3.1	3.4	3.6

COOLANT SYSTEM (HT circuit)

Number of cylinders			20	20	20
Coolant temperature (at engine connection: outlet to cooling system)	A	°C	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104
Coolant antifreeze content, max.	L	%	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7

COOLANT SYSTEM (LT circuit)

Number of cylinders			20	20	20
Coolant temperature before intercooler (at engine inlet inlet from cooling system)	A	°C	55	55	55
Coolant antifreeze content, max.	L	%	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7

LUBE OIL SYSTEM

Number of cylinders			20	20	20
Lube oil operating temperature before engine, from	R	°C	88	88	88
Lube oil operating temperature before engine, to	R	°C	98	98	98
Lube oil temperature before engine, warning	R	°C	99	99	99
Lube oil temperature before engine, shutdown	L	°C	101	101	101
Lube oil operating pressure before engine, from	R	bar	4.6	4.5	4.5
Lube oil operating pressure before engine, to	R	bar	7.4	7.3	7.3

FUEL SYSTEM

Number of cylinders			20	20	20
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine (when engine is starting), max.	L	bar	1.5	1.5	1.5

TIM-ID: 0000023556 - 001

GENERAL OPERATING DATA

Number of cylinders			20	20	20
Cold start capability: Air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32
Firing speed, from	R	rpm	80	80	80
Firing speed, to	R	rpm	120	120	120

CAPACITIES

Number of cylinders			20	20	20
Engine coolant capacity, engine side (without cooling system)	R	Liters	205	205	205
Charge-air coolant, engine side	R	Liters	30	30	30
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	390	390	390
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters			
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	245	245	245
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	340	340	340

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			20	20	20
Engine weight, dry (basic engine configuration acc. to scope of delivery specification)	R	kg	9290	9290	9290

ACOUSTICS

Number of cylinders			20	20	20
Engine surface noise with attenuated intake noise (filter) - DL (free-field sound power level Lp, 1 m distance, ISO 6798, +2dB(A) tolerance)	R	dB(A)	105	106	107
Engine surface noise with attenuated intake noise (filter) - DL (sound power level LW, ISO 6798, +2dB (A) tolerance)	R	dB(A)	124	125	125

TIM-ID: 0000023556 - 001

2.9 20 V 4000 Gx3 engine data: Standby operation 3D, optimized fuel consumption, 6ETC

Explanation:

DL Ref. value: Continuous power
BL Ref. value: Fuel stop power
A Design value
G Guaranteed value
r Guideline value
L Limit value, up to which the engine can be operated, without change (e.g. of power settings).
N Not yet defined value
- Not applicable
X Applicable

REFERENCE CONDITIONS

Engine model			20V 4000G23	20V 4000G43	20V 4000G63	20V 4000G63 L	20V 4000G83	20V 4000G83 L
Application group			3D	3D	3D	3D	3D	3D
Intake air temperature		°C	25	25	25	25	25	25
Charge-air coolant temperature		°C	55	55	55	55	55	55
Barometric pressure		mbar	1000	1000	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100	100	100

POWER-RELATED DATA (power ratings are net brake power as per ISO 3046)

Number of cylinders			20	20	20	20	20	20
Rated engine speed	A	rpm	1500	1800	1500	1500	1800	1800
Fuel stop power ISO 3046	A	kW	2420	2740	2670	2850	3010	3490

GENERAL CONDITIONS (for maximum power)

Number of cylinders			20	20	20	20	20	20
Intake depression (new filter)	A	mbar	15	15	15	15	15	15
Intake depression, max.	L	mbar	50	50	50	50	50	50

TIM-ID: 0000023453 - 001

MODEL-RELATED DATA (basic design)

Number of cylinders			20	20	20	20	20	20
Number of cylinders			20	20	20	20	20	20
Cylinder arrangement: V-angle		Degrees	90	90	90	90	90	90
Bore		mm	170	170	170	170	170	170
Stroke		mm	210	210	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77	4.77	4.77
Total displacement		Liters	95.4	95.4	95.4	95.4	95.4	95.4
Compression ratio			16.4	16.4	16.4	16.4	16.4	16.4
Inlet valves per cylinder			2	2	2	2	2	2
Number of exhaust valves per cylinder			2	2	2	2	2	2

COMBUSTION AIR / EXHAUST GAS

Number of cylinders			20	20	20	20	20	20
Charge-air pressure before cylinder - BL	r	bar abs	2.5	3.1	2.7	2.9	3.3	3.6

COOLANT SYSTEM (HT circuit)

Number of cylinders			20	20	20	20	20	20
Coolant temperature (at engine connection: outlet to cooling system)	A	°C	100	100	100	100	100	100
Coolant temperature after engine, warning	r	°C	102	102	102	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104	104	104	104
Coolant antifreeze content, max.	L	%	50	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7	0.7

TIM-ID: 0000023453 - 001

COOLANT SYSTEM (LT circuit)

Number of cylinders			20	20	20	20	20	20
Coolant temperature before intercooler (at engine inlet inlet from cooling system)	A	°C	55	55	55	55	55	55
Coolant antifreeze content, max.	L	%	50	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7	0.7

LUBE OIL SYSTEM

Number of cylinders			20	20	20	20	20	20
Lube oil operating temperature before engine, from	r	°C	88	88	88	88	88	88
Lube oil operating temperature before engine, to	r	°C	98	98	98	98	98	98
Lube oil temperature before engine, warning	r	°C	99	99	99	99	99	99
Lube oil temperature before engine, shutdown	L	°C	101	101	101	101	101	101
Lube oil operating pressure before engine, from	r	bar	4.5	5.0	4.3	4.3	4.9	4.8
Lube oil operating pressure before engine, to	r	bar	7.3	7.8	7.1	7.1	7.7	7.6
Lube oil pressure before engine, warning	r	bar	--	--	--	--	--	--
Lube oil pressure before engine, shutdown	L	bar	--	--	--	--	--	--

TIM-ID: 0000023453 - 001

FUEL SYSTEM

Number of cylinders			20	20	20	20	20	20
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Fuel pressure at supply connection to engine (when engine is starting), max.	L	bar	1.5	1.5	1.5	1.5	1.5	1.5

GENERAL OPERATING DATA

Number of cylinders			20	20	20	20	20	20
Cold start capability: Air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	10	10	10	10	10	10
Coolant preheating: Preheating temperature (min.)	R	°C	32	32	32	32	32	32
Firing speed, from	R	rpm	80	80	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120	120	120

CAPACITIES

Number of cylinders			20	20	20	20	20	20
Engine coolant capacity, engine side (without cooling system)	R	Liters	205	205	205	205	205	205
Charge-air coolant, engine side	R	Liters	30	30	30	30	30	30
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	390	390	390	390	390	390
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters						

TIM-ID: 0000023453 - 001

Number of cylinders			20	20	20	20	20	20
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	245	245	245	245	245	245
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	340	340	340	340	340	340

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			20	20	20	20	20	20
Engine weight, dry (basic engine configuration acc. to scope of delivery specification)	R	kg	9290	9290	9290	9290	9290	9290

ACOUSTICS

Number of cylinders			20	20	20	20	20	20
Engine surface noise with attenuated intake noise (filter) - BL (free-field sound power level Lp, 1 m distance, ISO 6798, +2dB(A) tolerance)	R	dB(A)	104	106	106	106	108	108
Engine surface noise with attenuated intake noise (filter) - BL (sound power level LW, ISO 6798, +2dB (A) tolerance)	R	dB(A)	123	125	125	125	126	127

TIM-ID: 0000023453 - 001

3 Operation

3.1 Putting the engine into operation after extended out-of-service periods (>3 months)

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Putting into operation after long out-of-service periods (>3 months)

Item	Action
Engine	Depreserve (→ MTU Fluids and Lubricants Specifications A001061/..).
Valve gear	Lubricate valve gear every ≥ 6 months (→ Page 112).
Lube oil system	Check engine oil level (→ Page 142).
Fuel prefilter	Fill with fuel (→ Page 132).
Fuel prefilter, pressure gauge	Align adjustable pointer with position of pressure indicator (→ Page 128).
Coolant circuit	If engine is out of service for more than one year, change engine coolant (→ Page 148). Change charge-air coolant (→ Page 156).
Coolant circuit	Check engine coolant level (→ Page 147); Check charge-air coolant level (→ Page 155).
Coolant circuit	Heat engine coolant with coolant preheating unit.
Engine governor	Check plug-in connections (→ Page 169).
Monitoring system	Carry out lamp test (see manufacturer's documentation).
Engine/generator control system	Switch ON; select operating mode, e.g. MANUAL, AUTOMATIC OPERATION.
HP fuel pump	Only for engines without oil priming pump Fill HP fuel pump with new engine oil (→ Page 118).

TIM-ID: 0000002195 - 001

3.2 Putting the engine into operation after scheduled out-of-service-period

Preconditions

☑ Engine is stopped and starting disabled.

Putting the engine into operation

Item	Task
Lube oil system	Check oil level (→ Page 142);
Cooling system	Check engine coolant level (→ Page 147); Check charge-air coolant level (→ Page 155).
Cooling system	Preheat coolant with preheating unit.
Fuel prefilter	Drain (→ Page 129).
Monitoring equipment	Carry out lamp test (see manufacturer's documentation).
Engine/generator control system	Switch ON; Select operating mode, e.g. MANUAL OPERATION, AUTOMATIC OPERATION.

TIM-ID: 0000002677 - 001

3.3 Start engine in manual mode (testing mode)

Preconditions

☑ Generator (if provided) not connected to network.

☑ External start interlock is not activated.

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Preparation

Item	Task
Operating mode selector switch (if provided)	Change to manual mode.
Preheating pump (if provided)	Switch ON.

Starting the engine

Item	Task
Switchgear cabinet, control panel etc. (depending on manufacturer)	If coolant temperature is • > 40 °C (with preheating equipment), or • > 5 °C (without preheating equipment): Press start button. • Automatic starting sequence is performed; • Engine speed display instrument indicates increasing crankshaft speed; • After the starting sequence is completed, engine is running at rated speed.

Connect generator to network (if provided), run engine to reach operating temperature)

Item	Task
Switchgear cabinet, control panel etc. (depending on manufacturer)	Close the generator circuit breaker.
Engine	Apply full load only after engine has reached operating temperature (coolant temperature approx. 75 °C).

TIM-ID: 0000002226 - 002

3.4 Safety system – Override

CAUTION

Safety functions and engine shutdown alarms will be disregarded.
Serious damage to plant!
- Initiate emergency start only in emergency situations.

CAUTION

Inadmissible operational condition.
Major material damage!
- Use override function only in hazardous situations to ensure full capability in case of engine malfunctions.

Preparation

Note: This function is only available when a pushbutton is provided.

Bypassing the safety system (Override)

Item	Action
Switchgear cabinet, control panel etc. (depending on manufacturer)	Activate pushbutton for Override input of the ECU. • Certain shutdown criteria and/or starting prerequisites are ignored.
Switchgear cabinet, control panel etc. (depending on manufacturer)	Actuate start button, for further starting sequence, refer to engine start (→ Page 42).
Control and display panels	During operation, check the displayed operational data (speed, temperature, pressures). Constantly monitor plant limit values.

TIM-ID: 0000000984 - 002

3.5 Operational checks

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Operational checks

Item	Measure
Control and display panels	Check readings of operational data (speed, temperature, pressures).
Engine oil	Check engine oil level (→ Page 142)
Engine under load Engine at nominal speed	Check engine/plant and piping for leaks, repair leaky pipes with the engine stopped (exhaust lines and turbocharger turbine housings may be red-hot. If the maximum exhaust temperatures are not exceeded, no restrictions in engine operation are required) Check for abnormal running noises and vibration.
Fuel prefilter	Check reading on differential pressure gauge to ensure that maximum permissible value is not exceeded (→ Page 128).
Exhaust system	Check exhaust color (→ Page 52).
Intercooler	Check condensate drain(s) for water discharge and obstruction (→ Page 134).
Air filter	Check signal ring position of contamination indicator (→ Page 138). Replace air filter (→ Page 135) if the signal ring is completely visible in the contamination indicator control window.
Engine coolant pump	Check relief bore (→ Page 153).
Charge-air coolant pump	Check relief bore (→ Page 161).
Compressed-air system (if installed)	Check operating pressure on pressure gauge; Always fill compressed-air tank to max. pressure; Drain condensate from compressed-air tank, pressure drop must not exceed 1 bar.

TIM-ID: 0000002258 - 003

3.6 Starting the engine in emergency situations (override mode)

CAUTION

Safety functions and engine shutdown alarms will be disregarded.
Serious damage to plant!
- Initiate emergency start only in emergency situations.

Preparation

Item	Task
Operating mode switch	Set to emergency mode.

Starting the engine in emergency situations

Item	Task
Control cabinet	Actuate switch/button for ECU override input.
Control cabinet	• Automatic starting procedure is performed; any safety functions and alarms leading to engine shutdown are disregarded; • Tachometer indicates increasing crankshaft speed; • Engine is running at rated speed when the starting sequence is completed.

Connecting the generator (if fitted) to mains

Item	Task
Control cabinet	If generator is not connected to mains: Close generator circuit breaker.
Engine	Operate engine at rated power.

TIM-ID: 0000010685 - 001

3.7 Stop engine in manual mode (testing mode)

Preconditions

☑ Generator (if provided) not connected to network.

☑ Engine is running in manual mode.

CAUTION

Stopping the engine when it is running at full load causes extreme stress to the engine.
Risk of overheating, damage to components!
- Before stopping the engine, operate it at idle speed until operating temperatures decrease and stable values are indicated.

Preparing the generator drive (only with generator breaker)

Item	Task
Engine	After opening the generator breaker (if provided), allow to cool down off-load for approx. 5 minutes.

Preparing the pump drive (diesel-mechanical/diesel-electric)

Item	Task
Engine	Allow to cool down for approx. 5 minutes at reduced engine speed. Observe natural resonance of engine (installation-dependent)!

Stopping the engine

Item	Task
Switchgear cabinet, control panel etc. (depending on manufacturer)	Press stop button. • Automatic stopping sequence is performed; • Engine is stopped.

After stopping the engine

Item	Task
Coolant pump	Allow to run on for sufficient time after stopping.

TIM-ID: 0000002285 - 001

3.8 Emergency stop

CAUTION

An emergency stop causes extreme stress to the engine.
Risk of overheating, damage to components!
- Initiate emergency stop only in emergency situations.

Emergency stop from LOP

Item	Task
EMERGENCY STOP button	Press. • Engine is stopped by switching off power supply to ECU; • Signalization (e.g. by horn, flashing lamp) is released.

After emergency stop from LOP

Item	Task
Switching cabinet, control panel etc. (depending on manufacturer)	Press button for alarm acknowledgement. • Audible and visual signalization stops.

TIM-ID: 0000002305 - 002

3.9 After stopping the engine – Engine remains ready for operation

After stopping the engine

Item	Action
Engine/generator/pump control	Select operating mode, e.g. MANUAL, AUTOMATIC OPERATION.

TIM-ID: 0000000983 - 002

3.10 After stopping the engine – putting the engine out of service

Preconditions

☑ MTU Fluids and Lubricants Specifications (A001061/..) is available.

After stopping the engine

Item	Task
Cooling system	Drain engine coolant (→ Page 149); Drain charge-air coolant (→ Page 157) if: • freezing temperatures are expected and the engine is to remain out of service for an extended period and coolant has no antifreeze additive; • the engine room is not heated; • the coolant is not maintained at a suitable temperature; • the antifreeze concentration is insufficient for the engine-room temperature; • antifreeze concentration is 50 % and engine-room temperature is below -40°C.
Engine/generator/pump controller	Switch OFF.
Air intake and exhaust system	If the engine is to remain out of service for more than 1 week, seal the engine's air and exhaust sides. If the engine is to remain out of service for more than 1 month, preserve engine (→ MTU Fluids and Lubricants Specifications A001061/..).

TIM-ID: 0000002706 - 001

3.11 Plant cleaning

Preconditions

☑ Engine is stopped and starting disabled.

☑ Operating voltage is not present.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Steam jet cleaner	-	1
Cleaner (Hakupur 312)	30390	1

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

WARNING

Water jet.
Risk of injury and scalding!
- Do not direct water jet at persons.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

Excessive reaction time of cleaning agents on components.
Damage to component!
- Observe manufacturer's instructions.
- Wear protective clothing, gloves, and goggles / safety mask.

NOTICE

Dry with compressed air.
Damage to component!
- Never aim compressed air directly at electronic components.

Plant cleaning

1. Carry out plant cleaning only in areas where an appropriate oil separator is provided (environmental protection).
2. Prior to putting the cleaning unit into operation, read the Operating Instructions of the water/steam jet unit carefully and observe the safety precautions.
3. During external cleaning of the plant with water/steam-jet units, the pressure of the high-pressure jet (cleaning jet) must not exceed 50 bar. A minimum distance between spray nozzle and plant of 1 m must be observed. The temperature of the cleaning medium must not exceed 80 °C.
4. For external cleaning with high-pressure jet, use a flat-mouth nozzle only.
5. Carry out external cleaning as follows:
   a) Seal all openings in a suitable fashion.
   b) Remove coarse dirt.
   c) Spray on cleaner sparingly and leave it for 1 to 5 minutes.
   d) Use the high-pressure jet to remove the loosened dirt.

Note: Never aim compressed air directly at electronic components.

   e) Dry engine.

TIM-ID: 0000010171 - 024

4 Maintenance

4.1 Maintenance task reference table [QL1]

The maintenance tasks and intervals for this product are defined in the Maintenance Schedule. The Maintenance Schedule is a stand-alone publication.

The task numbers in this table provide reference to the maintenance tasks specified in the Maintenance Schedule.

Task	Maintenance tasks	
W0500	Check engine oil level.	(→ Page 142)
W0501	Visually inspect engine for leaks and general condition.	(→ Page 44)
W0502	Check intercooler drain(s).	(→ Page 134)
W0503	Check signal ring position of service indicator on air filter.	(→ Page 138)
W0505	Check relief bores of water pump(s).	(→ Page 153)
W0506	Check engine for abnormal running noises, exhaust color and vibrations.	(→ Page 44)
W0507	Drain water and contaminants from fuel prefilter.	(→ Page 44)
W0508	Check reading on vacuum gauge at fuel prefilter.	(→ Page 44)
W0534	Carry out test run, minimum duration: until steady-state temperature is reached, no less than 1/3 load (monthly).	(→ Page 106)
W1001	Replace fuel filter or fuel filter element.	(→ Page 126)
W1005	Replace air filter.	(→ Page 135)
W1006	Replace injection valves/injectors.	(→ Page 119)
W1008	Replace engine oil filter when changing engine oil, or when the interval (years) is reached, at the latest.	(→ Page 144)
W1009	Check layer thickness of the oil residue, clean out and replace filter sleeve, at every oil change, at the latest.	(→ Page 145)
W1011	Perform endoscopic examination.	(→ Page 107)
W1207	Check valve clearance, adjust if necessary. Attention!First adjustment after 1,000 operating hours!	(→ Page 113)
W1241	Check condition of drive belt, replace if necessary; adjust belt tension.	(→ Page 162)
W1463	Check general condition of engine mounting (visual inspection).	(→ Page 166)
W1547	Replace oil mist separator.	(→ Page 111)
W1713	Injector: Reset drift correction parameters (CDC).	(→ Page 167)
W1714	Check and clean oil indicator filter (if fitted).	-

Table 1: Maintenance task reference table [QL1]

TIM-ID: 0000019908 - 002

5 Troubleshooting

5.1 Troubleshooting

Engine does not turn when starter is actuated

Component	Probable cause	Task
Battery	Low or defective	Charge or replace (see manufacturer's documentation).
	Cable connections defective	Check if cable connections are properly secured (see manufacturer's documentation).
Starter (electric)	Engine wiring or starter defective	Check cable connections for secure seating, Contact Service.
Starter (compressed air)	Cabling on starting valve or starter defective	Check cable connections for secure seating, Contact Service.
Engine wiring	Defective	Check (→ Page 165).
Engine/generator control system	Secure seating of assemblies or connectors not provided	Perform visual inspection (see manufacturer's documentation).
Engine Governor	Plug-in connections are loose	Check plug connections (→ Page 169).
Engine	Running gear blocked (engine cannot be barred manually)	Contact Service.

Engine turns but does not fire

Component	Probable cause	Task
Starter (electric)	Poor rotation by starter: Battery low or defective	Charge or replace battery (see manufacturer's documentation).
Starter (compressed air)	Poor rotation by starter: Air pressure too low	Check compressed air system.
Engine wiring	Defective	Check (→ Page 165).
Fuel system	Not vented	Vent fuel system (→ Page 125).
Engine Governor	Defective	Contact Service.

Engine fires unevenly

Component	Probable cause	Task
Fuel injection equipment	Injector defective	Replace (→ Page 119).
Engine wiring	Defective	Check (→ Page 165).
Fuel system	Not vented	Vent fuel system (→ Page 125).
Engine Governor	Defective	Contact Service.

TIM-ID: 0000002537 - 001

Engine does not reach nominal speed

Component	Probable cause	Task
Fuel supply	Fuel prefilter clogged	Replace (→ Page 132).
	Easy-change fuel filter clogged	Replace (→ Page 126).
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 138).
Fuel injection equipment	Injector defective	Replace (→ Page 119).
Engine wiring	Defective	Check (→ Page 165).
Engine	Overloaded	Contact Service.

Engine speed not steady

Component	Probable cause	Task
Fuel injection equipment	Injector defective	Replace (→ Page 119).
Speed sensor	Defective	Contact Service.
Fuel system	Not vented	Vent fuel system (→ Page 125).
Engine Governor	Defective	Contact Service.

Charge-air temperature too high

Component	Probable cause	Task
Engine coolant	Incorrect coolant concentration	Check (MTU test kit).
Intercooler	Contaminated	Contact Service.
Engine room	Air-intake temperature too high	Check fans and air supply / ventilation ducts.

Charge air pressure too low

Component	Probable cause	Task
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 138).
Intercooler	Contaminated	Contact Service.
Exhaust turbocharger	Defective	Contact Service.

Coolant leaks on intercooler

Component	Probable cause	Task
Intercooler	Leaking, major coolant discharge	Contact Service.

Exhaust gas black

Component	Probable cause	Task
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 138).
Fuel injection equipment	Injector defective	Replace (→ Page 119).
Engine	Overloaded	Contact Service.

TIM-ID: 0000002537 - 001

Exhaust gas blue

Component	Probable cause	Task
Engine oil	Too much engine oil in the engine	Drain engine oil (→ Page 140).
	Oil separator of crankcase breather contaminated	Replace (→ Page 111).
Exhaust turbocharger, cylinder head, piston rings, cylinder liner	Defective	Contact Service.

Exhaust gas white

Component	Probable cause	Task
Engine	Not at operating temperature	Run engine to reach operating temperature.
Fuel system	Water in fuel	Check fuel system on fuel prefilter. Drain fuel prefilter (→ Page 129).
Intercooler	Leaking	Contact Service.

TIM-ID: 0000002537 - 001

5.2 Engine governor ADEC (ECU 7) for Series 4000 genset engines – Fault messages

003 – HI T-Fuel

ZKP-Number: 2.0122.931

Limit value 1

Cause	Corrective action
Fuel temperature too high.	▶ Contact Service.

004 – SS T-Fuel

ZKP-Number: 2.0122.932

Limit value 2

Cause	Corrective action
Fuel temperature too high; engine shutdown.	▶ Contact Service.

005 – HI T-Charge Air

ZKP-Number: 2.0121.931

Limit value 1

Cause	Corrective action
Charge-air temperature too high.	1. Reduce power. 2. Check intercooler.

006 – SS T-Charge Air

ZKP-Number: 2.0121.932

Limit value 2

Cause	Corrective action
Charge-air temperature too high; engine shutdown.	1. Reduce power. 2. Check intercooler.

009 – HI T-Coolant Intercooler

ZKP-Number: 2.0124.931

Limit value 1

Cause	Corrective action
Coolant temperature in intercooler too high.	▶ Reduce power.

TIM-ID: 0000008506 - 001

010 – SS T-Coolant Intercooler

ZKP-Number: 2.0124.932

Limit value 2

Cause	Corrective action
Coolant temperature in intercooler too high; engine shutdown.	▶ Reduce power.

015 – LO P-Lube Oil

ZKP-Number: 2.0100.921

Limit value 1

Cause	Corrective action
Lube oil pressure too low.	▶ Check oil level, top up as necessary (→ Page 142).

016 – SS P-Lube Oil

ZKP-Number: 2.0100.922

Limit value 2

Cause	Corrective action
Lube oil pressure too low; engine shutdown.	1. Check oil level, top up as necessary (→ Page 142). 2. Attempt to restart engine (→ Page 42).

019 – HI T-Exhaust A

ZKP-Number: 2.0126.931

Limit value 1

Cause	Corrective action
Exhaust gas temperature (A-side) too high.	1. Check cabling (→ Page 165). 2. Contact Service.

020 – SS T-Exhaust A

ZKP-Number: 2.0126.932

Limit value 2

Cause	Corrective action
Exhaust gas temperature (A-side) too high; engine shutdown.	1. Check cabling (→ Page 165). 2. Contact Service.

021 – HI T-Exhaust B

ZKP-Number: 2.0127.931

Limit value 1

Cause	Corrective action
Exhaust gas temperature (B-side) too high.	1. Check cabling (→ Page 165). 2. Contact Service.

TIM-ID: 0000008506 - 001

022 – SS T-Exhaust B

ZKP-Number: 2.0127.932

Limit value 2

Cause	Corrective action
Exhaust gas temperature (B-side) too high; engine shutdown.	1. Check cabling (→ Page 165). 2. Contact Service.

023 – LO Coolant Level

ZKP-Number: 2.0152.921

Limit value 1

Cause	Corrective action
Coolant level too low.	▶ Check coolant level in expansion tank (→ Page 147).

025 – HI P-Diff. Lube Oil

ZKP-Number: 2.0154.931

Limit value 1

Cause	Corrective action
Oil filter differential pressure too high.	▶ Replace oil filter (→ Page 144).

026 – HI P-Diff. Lube Oil

ZKP-Number: 2.0154.932

Limit value 2

Cause	Corrective action
Oil filter differential pressure too high.	▶ Replace oil filter (→ Page 144).

027 – HI Leak Fuel Level

ZKP-Number: 2.0151.931

Limit value 1

Cause	Corrective action
Leak-fuel level too high.	1. Check fuel system. 2. Contact Service.

029 – HI ETC 2 idle speed

ZKP-Number: 1.8004.206

Cause	Corrective action
Idle speed of ETC 2 too high.	▶ Contact Service.

TIM-ID: 0000008506 - 001

030 – SS Engine Speed

ZKP-Number: 2.2510.932

Limit value 2

Cause	Corrective action
Reduced fuel injection.	1. Acknowledge alarm. 2. Attempt to restart engine.

031 – HI ETC 1 overspeed

ZKP-Number: 2.3011.931

Limit value 1

Cause	Corrective action
Speed of primary turbocharger too high.	▶ Contact Service.

032 – SS ETC 1 overspeed

ZKP-Number: 2.3012.932

Limit value 2

Cause	Corrective action
Speed of primary turbocharger too high.	1. Automatic power reduction by engine control system. 2. Check air filters (→ Page 136).

33 – HI P-Diff-Fuel

ZKP-Number: 20.114.931

Limit value 1

Cause	Corrective action
Fuel filter differential pressure too high.	▶ Replace fuel filter (→ Page 126).

34 – SS P-Diff-Fuel

ZKP-Number: 20.114.932

Limit value 2

Cause	Corrective action
Fuel filter differential pressure too high.	▶ Replace fuel filter (→ Page 126).

036 – HI ETC 2 Overspeed

ZKP-Number: 2.3013.931

Limit value 1

Cause	Corrective action
Speed of first secondary turbocharger too high.	1. Reduce power. 2. Contact Service.

TIM-ID: 0000008506 - 001

037 – SS ETC 2 Overspeed

ZKP-Number: 2.3013.912

Limit value 2

Cause	Corrective action
Speed of first secondary turbocharger too high.	1. Reduce power. 2. Contact Service.

038 – AL ETC Speed Deviation

ZKP-Number: 1.8004.205

Cause	Corrective action
Synchronization fault between primary turbocharger and one of the secondary turbochargers.	1. Reduce power. 2. Contact Service.

039 – AL ETC 2 Cutin Failure

ZKP-Number: 1.8004.204

Cause	Corrective action
ETC 2 failed to cut in.	1. Reduce power. 2. Contact Service.

044 – LO Coolant Level Intercooler

ZKP-Number: 2.0153.921

Limit value 1

Cause	Corrective action
Intercooler coolant level too low.	▶ Check coolant level (→ Page 155).

051 – HI T-Lube Oil

ZKP-Number: 2.0125.931

Limit value 1

Cause	Corrective action
Lube oil temperature too high.	▶ Reduce power.

052 – SS T-Lube Oil

ZKP-Number: 2.0125.932

Limit value 2

Cause	Corrective action
Lube oil temperature too high; engine shutdown.	1. Reduce power. 2. Check engine oil level (→ Page 142).

TIM-ID: 0000008506 - 001

057 – LO P-Coolant

ZKP-Number: 2.0101.921

Limit value 1

Cause	Corrective action
Coolant pressure too low.	▶ Check coolant circuit.

058 – SS P-Coolant

ZKP-Number: 2.0101.922

Limit value 2

Cause	Corrective action
Coolant pressure too low; engine shutdown or reduction of fuel injection.	1. Automatic engine shutdown. 2. Check coolant level (→ Page 147).

59 – SS T-Coolant L3

ZKP-Number: 20.120.933

Limit value 3

Cause	Corrective action
Coolant temperature too high/ low	1. Allow engine to cool down; 2. Check coolant cooler, clean if necessary. 3. Contact Service.

60 – SS T-Coolant L4

ZKP-Number: 20.120.934

Limit value 4

Cause	Corrective action
Coolant temperature too high/ low	1. Allow engine to cool down; 2. Check coolant cooler, clean if necessary. 3. Contact Service.

063 – HI P-Crankcase

ZKP-Number: 2.0106.931

Limit value 1

Cause	Corrective action
Crankcase pressure too high.	1. Reduce power. 2. Replace oil separator element (→ Page 111).

TIM-ID: 0000008506 - 001

064 – SS P-Crankcase

ZKP-Number: 2.0106.932

Limit value 2

Cause	Corrective action
Crankcase pressure too high; engine shutdown.	1. Replace oil separator element (→ Page 111). 2. Contact Service.

065 – LO P-Fuel

ZKP-Number: 2.0102.921

Limit value 1

Cause	Corrective action
Fuel supply pressure too low.	1. Check fuel lines for leaks. 2. Clean fuel prefilter (→ Page 127). 3. Flush fuel prefilter (→ Page 130). 4. Replace filter element of fuel prefilter (→ Page 132). 5. Replace fuel filter (→ Page 126).

066 – SS P-Fuel

ZKP-Number: 2.0102.922

Limit value 2

Cause	Corrective action
Fuel supply pressure too low; engine shutdown.	1. Check fuel lines for leaks. 2. Clean fuel prefilter (→ Page 127). 3. Flush fuel prefilter (→ Page 130). 4. Replace filter element of fuel prefilter (→ Page 132). 5. Replace fuel filter (→ Page 126).

067 – HI T-Coolant

ZKP-Number: 2.0120.931

Limit value 1

Cause	Corrective action
Coolant temperature too high.	▶ Reduce power.

068 – SS T-Coolant

ZKP-Number: 2.0120.932

Limit value 2

Cause	Corrective action
Coolant temperature too high; engine shutdown.	1. Allow engine to cool down; 2. Check coolant cooler, clean if necessary. 3. Restart engine (→ Page 42). 4. Contact Service.

TIM-ID: 0000008506 - 001

081 – AL Rail Leakage

ZKP-Number: 1.8004.046

Cause	Corrective action
Pressure gradient in common rail too low during engine start or too high during engine stop; HP fuel system leaky, air in system.	▶ Contact Service.

082 – HI P-Fuel (Common Rail)

ZKP-Number: 2.0104.931

Cause	Corrective action
Rail pressure > set-point value; DBR reduction, start of injection moved to late; suction restrictor jamming or wiring of suction restrictor faulty.	▶ Contact Service.

083 – LO P-Fuel (Common Rail)

ZKP-Number: 2.0104.921

Cause	Corrective action
Rail pressure > set-point value; DBR reduction, suction restrictor faulty or leak in HP fuel system.	▶ Contact Service.

085 – HI T-Recirculation

ZKP-Number: 2.0128.931

Limit value 1

Cause	Corrective action
Recirculation temperature too high.	▶ Reduce power.

086 – HI T-Recirculation

ZKP-Number: 2.0128.932

Limit value 2

Cause	Corrective action
Recirculation temperature too high.	▶ Reduce power.

089 – SS Engine Speed too Low

ZKP-Number: 2.2500.030

Cause	Corrective action
Engine speed too low.	▶ Check for additional messages.

TIM-ID: 0000008506 - 001

090 – SS Starter Speed Not Reached

ZKP-Number: 2.1090.925

Cause	Corrective action
Idling speed was not attained.	▶ Contact Service.

091 – SS Release Speed Not Reached

ZKP-Number: 2.1090.924

Cause	Corrective action
Runup speed was not attained.	▶ Contact Service.

092 – SS Starter Speed Not Reached

ZKP-Number: 2.1090.923

Cause	Corrective action
Starter speed was not attained; termination of start sequence; starter rotates too low or not at all.	▶ Contact Service.

093 – SS T-Preheat

ZKP-Number: 2.1090.922

Limit value 2

Cause	Corrective action
Preheating temperature too low; coolant temperature too low for engine start ; engine start interlock.	▶ Check preheater.

094 – LO T-Preheat

ZKP-Number: 2.1090.921

Limit value 1

Cause	Corrective action
Preheating temperature too low; coolant temperature too low for engine start.	▶ Check preheater.

095 – AL Prelubrication Fault

ZKP-Number: 2.1090.920

Cause	Corrective action
oil priming failure.	▶ Check oil priming system.

TIM-ID: 0000008506 - 001

102 – AL Consumption Meter Faulty

ZKP-Number: 1.8004.624

Cause	Corrective action
consumption meter faulty.	▶ Contact Service.

104 – AL Eng Hours Counter Defect

ZKP-Number: 1.8004.623

Cause	Corrective action
hour meter faulty.	▶ Contact Service.

118 – LO ECU Supply Voltage

ZKP-Number: 2.0140.921

Limit value 1

Cause	Corrective action
Supply voltage too low.	1. Check ECU supply voltage. 2. Contact Service.

119 – LOLO ECU Supply Voltage

ZKP-Number: 2.0140.922

Limit value 2

Cause	Corrective action
Supply voltage too low.	1. Check ECU supply voltage. 2. Contact Service.

120 – HI ECU Supply Voltage

ZKP-Number: 2.0140.931

Limit value 1

Cause	Corrective action
Supply voltage too high.	1. Check ECU supply voltage. 2. Contact Service.

121 – HIHI ECU Supply Voltage

ZKP-Number: 2.0140.932

Limit value 2

Cause	Corrective action
Supply voltage too high.	1. Check ECU supply voltage. 2. Contact Service.

TIM-ID: 0000008506 - 001

122 – HI T-ECU

ZKP-Number: 2.0132.921

Limit value 1

Cause	Corrective action
Electronic unit temperature too high.	1. Reduce power. 2. Improve engine room ventilation.

141 – AL Power too high

ZKP-Number: 11.088.007

Cause	Corrective action
This alarm is activated when the average power of the last 24 hours exceeded the maximum value set in PR1.1088.001.	▶ Reduce power.

142 – AL MCR exceeded 1 hour

ZKP-Number: 1.1088.006

Cause	Corrective action
This alarm is activated when the MCR was exceeded for more than one hour within the last 12 hours.	▶ Reduce power.

176 – AL LifeData Not Avail

ZKP-Number: 2.4000.004

Cause	Corrective action
No (appropriate) LifeData backup system available, ECU reset after expiration of time-out period.	▶ Contact Service.

177 – AL LifeData restore incomplete

ZKP-Number: 2.4000.006

Cause	Corrective action
This error message is generated if a CRC is faulty during a data upload to ADEC (indicated for each individual module).	▶ Contact Service.

TIM-ID: 0000008506 - 001

180 – AL CAN1 Node Lost

ZKP-Number: 2.0500.680

Cause	Corrective action
Connection to one node on CAN bus 1 failed.	▶ Contact Service.

181 – AL CAN2 Node Lost

ZKP-Number: 2.0500.681

Cause	Corrective action
Connection to one node on CAN bus 2 failed.	▶ Contact Service.

182 – AL CAN Wrong Parameters

ZKP-Number: 2.0500.682

Cause	Corrective action
Incorrect parameter values entered in data record.	▶ Contact Service.

183 – AL CAN No PU-Data

ZKP-Number: 2.0500.683

Cause	Corrective action
ACAN mode has been selected in which communication with the PU data module is initialized. However, the required PU data module is not available or not valid.	▶ Contact Service.

184 – AL CAN PU-Data Flash Error

ZKP-Number: 2.0500.684

Cause	Corrective action
A programming error occurred when attempting to copy a received PU data module into the Flash module.	▶ Contact Service.

186 – AL CAN1 Bus Off

ZKP-Number: 2.0500.686

Cause	Corrective action
CAN controller 1 is in “Bus-Off” status.	1. Inspect CAN bus for short circuit and rectify short circuit as necessary. 2. Check shielding, improve as necessary. 3. Contact Service.

TIM-ID: 0000008506 - 001

187 – AL CAN1 Error Passive

ZKP-Number: 2.0500.687

Cause	Corrective action
CAN controller 1 has signaled a warning.	1. Inspect CAN bus for short circuit and rectify short circuit as necessary. 2. Check shielding, improve as necessary. 3. Contact Service.

188 – AL CAN2 Bus Off

ZKP-Number: 2.0500.688

Cause	Corrective action
CAN controller 2 is in “Bus-Off” status. => Automatic changeover to CAN 1; short circuit, massive interference or Baud rate incompatibility.	1. Inspect CAN bus for short circuit and rectify short circuit as necessary. 2. Check shielding, improve as necessary. 3. Contact Service.

189 – AL CAN2 Error Passive

ZKP-Number: 2.0500.689

Cause	Corrective action
CAN controller 2 has signaled a warning.	1. Inspect CAN bus for short circuit and rectify short circuit as necessary. 2. Check shielding, improve as necessary. 3. Contact Service.

190 – AL EMU Parameter Not Supported

ZKP-Number: 2.0500.690

Cause	Corrective action
EMU parameter are not supported.	▶ Contact Service.

201 – SD T-Coolant

ZKP-Number: 1.8004.570

Cause	Corrective action
Coolant temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B6), replace as necessary. Error cleared after restarting the engine.

202 – SD T-Fuel

ZKP-Number: 1.8004.572

Cause	Corrective action
Fuel temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B33), replace as necessary. Error cleared after restarting the engine.

TIM-ID: 0000008506 - 001

203 – SD T-Charge Air

ZKP-Number: 1.8004.571

Cause	Corrective action
Charge-air temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B9), replace as necessary. Error cleared after restarting the engine.

204 – SD Level Lube Oil

ZKP-Number: 1.8004.602

Cause	Corrective action
Lube-oil level sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

205 – SD T-Coolant Intercooler

ZKP-Number: 1.8004.574

Cause	Corrective action
Coolant temperature sensor of intercooler faulty; short circuit or wire break.	▶ Check sensor and cabling (B26), replace as necessary. Error cleared after restarting the engine.

206 – SD T-Exhaust A

ZKP-Number: 1.8004.576

Cause	Corrective action
Exhaust temperature sensor on A-side faulty; short circuit or wire break.	▶ Check sensor and cabling (B4.21), replace as necessary. Error cleared after restarting the engine.

207 – SD T-Exhaust B

ZKP-Number: 18.004.577

Cause	Corrective action
Exhaust temperature sensor on B-side faulty; short circuit or wire break.	▶ Check sensor and cabling (B4.22), replace as necessary.

208 – SD P-Charge Air

ZKP-Number: 1.8004.566

Cause	Corrective action
Charge-air pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B10), replace as necessary. Error cleared after restarting the engine.

TIM-ID: 0000008506 - 001

211 – SD P-Lube Oil

ZKP-Number: 1.8004.563

Cause	Corrective action
Lube-oil pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B5), replace as necessary. Error cleared after restarting the engine.

212 – SD P-Coolant

ZKP-Number: 1.8004.564

Cause	Corrective action
Coolant pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B16), replace as necessary. Error cleared after restarting the engine.

213 – SD P-Coolant Intercooler

ZKP-Number: 1.8004.569

Cause	Corrective action
Coolant pressure sensor of intercooler faulty; short circuit or wire break.	▶ Check sensor and cabling (B43), replace as necessary. Error cleared after restarting the engine.

214 – SD P-CrankCase

ZKP-Number: 1.8004.568

Cause	Corrective action
Crankcase pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B50), replace as necessary. Error cleared after restarting the engine.

215 – SD P-HD

ZKP-Number: 1.8004.567

Cause	Corrective action
Rail pressure sensor faulty; HP fuel regulator in emergency mode==> short circuit or wire break.	▶ Check sensor and cabling (B48), replace as necessary. Error cleared after restarting the engine.

216 – SD T-Lube Oil

ZKP-Number: 1.8004.575

Cause	Corrective action
Lube-oil temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B7), replace as necessary. Error cleared after restarting the engine.

TIM-ID: 0000008506 - 001

219 – SD T-Intake Air

ZKP-Number: 1.8004.573

Cause	Corrective action
Intake air temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B3), replace as necessary. Error cleared after restarting the engine.

220 – SD Coolant Level

ZKP-Number: 1.8004.584

Cause	Corrective action
Coolant level sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (F33), replace as necessary. Error cleared after restarting the engine.

221 – HI P-Diff Lube Oil

ZKP-Number: 1.8004.585

Cause	Corrective action
Lube-oil differential pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (F25), replace as necessary. Error cleared after restarting the engine.

222 – SD Level Leakage Fuel

ZKP-Number: 1.8004.582

Cause	Corrective action
Leak-fuel level sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (F46), replace as necessary. Error cleared after restarting the engine.

223 – SD Level Coolant Intercooler

ZKP-Number: 1.8004.583

Cause	Corrective action
Coolant level sensor of intercooler faulty; short circuit or wire break.	▶ Check sensor and cabling (F57), replace as necessary. Error cleared after restarting the engine.

227 – SD P-Oil bef. Filter

ZKP-Number: 1.8004.620

Cause	Corrective action
Lube-oil pressure sensor before filter faulty; short circuit or wire break.	▶ Check sensor and cabling (B5.3), replace as necessary. Error cleared after restarting the engine.

TIM-ID: 0000008506 - 001

228 – SD P-Fuel before Filter

ZKP-Number: 18.004.595

Cause	Corrective action
Fuel pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B5.3), replace as necessary.

229 – AL Stop Camshaft Sensor Defect

ZKP-Number: 1.8004.562

Cause	Corrective action
engine stop due to camshaft sensor fault (and a prior crankshaft sensor fault in the same operating cycle).	▶ Check connector and cabling to sensor B1, replace as necessary. Error cleared after restarting the engine.

230 – SD Crankshaft Speed

ZKP-Number: 1.8004.498

Cause	Corrective action
Crankshaft speed sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B13), replace as necessary. Error cleared after restarting the engine.

231 – SD Camshaft Speed

ZKP-Number: 1.8004.499

Cause	Corrective action
Camshaft speed sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B1), replace as necessary. Error cleared after restarting the engine.

232 – SD Charger 1 Speed

ZKP-Number: 1.3011.128

Cause	Corrective action
Speed sensor of primary turbocharger faulty; short circuit or wire break.	▶ Check sensor and cabling (B44.1), replace as necessary. Error cleared after restarting the engine.

233 – SD Charger 2 Speed

ZKP-Number: 1.3011.129

Cause	Corrective action
Speed sensor of secondary turbocharger faulty; short circuit or wire break.	▶ Check sensor and cabling (B44.2), replace as necessary. Error cleared after restarting the engine.

TIM-ID: 0000008506 - 001

239 – SD P-Diff Fuel

ZKP-Number: 18.004.598

Cause	Corrective action
Fuel differential pressure sensor faulty. This alarm occurs only in combination with the alarm SD P-Fuel before Filter or SD P-Fuel after Filter.	▶ Note further fault messages.

240 – SD P-Fuel

ZKP-Number: 1.8004.565

Cause	Corrective action
Fuel pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B34), replace as necessary. Error cleared after restarting the engine.

241 – SD T-Umblasen

ZKP-Number: 1.8004.581

Cause	Corrective action
Recirculation temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B49), replace as necessary. Error cleared after restarting the engine.

242 – SD T-Coolant (R)

ZKP-Number: 1.8004.622

Cause	Corrective action
Redundant coolant temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

244 – SD P-Lube Oil (R)

ZKP-Number: 1.8004.621

Cause	Corrective action
Redundant lube-oil pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

245 – SD ECU Supply Voltage

ZKP-Number: 2.8006.589

Cause	Corrective action
Internal ECU fault; electronic block faulty.	▶ Replace ECU.

TIM-ID: 0000008506 - 001

266 – SD Speed Demand

ZKP-Number: 2.8006.586

Cause	Corrective action
Analog speed demand signal faulty; short circuit or wire break.	1. Check cabling. 2. Check speed demand signal.

268 – SD Spinning Value

ZKP-Number: 28.006.591

Cause	Corrective action
Analog wheel slip signal faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

269 – SD Loadp.Analog filt

ZKP-Number: 2.8006.588

Cause	Corrective action
Filtered analog load pulse signal missing; short circuit or wire break.	▶ Check cabling, replace as necessary. Error cleared after restarting the engine.

270 – SD Frequency Input

ZKP-Number: 2.8006.590

Cause	Corrective action
Frequency input faulty; short circuit or wire break.	1. Check cabling. 2. Check setpoint speed transmitter. 3. Contact Service.

301 – AL Timing Cylinder A1

ZKP-Number: 1.8004.500

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

302 – AL Timing Cylinder A2

ZKP-Number: 1.8004.501

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

TIM-ID: 0000008506 - 001

303 – AL Timing Cylinder A3

ZKP-Number: 1.8004.502

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

304 – AL Timing Cylinder A4

ZKP-Number: 1.8004.503

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

305 – AL Timing Cylinder A5

ZKP-Number: 1.8004.504

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

306 – AL Timing Cylinder A6

ZKP-Number: 1.8004.505

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

307 – AL Timing Cylinder A7

ZKP-Number: 1.8004.506

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

TIM-ID: 0000008506 - 001

308 – AL Timing Cylinder A8

ZKP-Number: 1.8004.507

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

309 – AL Timing Cylinder A9

ZKP-Number: 1.8004.508

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

310 – AL Timing Cylinder A10

ZKP-Number: 1.8004.509

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

311 – AL Timing Cylinder B1

ZKP-Number: 1.8004.510

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

312 – AL Timing Cylinder B2

ZKP-Number: 1.8004.511

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

TIM-ID: 0000008506 - 001

313 – AL Timing Cylinder B3

ZKP-Number: 1.8004.512

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

314 – AL Timing Cylinder B4

ZKP-Number: 1.8004.513

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

315 – AL Timing Cylinder B5

ZKP-Number: 1.8004.514

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

316 – AL Timing Cylinder B6

ZKP-Number: 1.8004.515

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

317 – AL Timing Cylinder B7

ZKP-Number: 1.8004.516

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

TIM-ID: 0000008506 - 001

318 – AL Timing Cylinder B8

ZKP-Number: 1.8004.517

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

319 – AL Timing Cylinder B9

ZKP-Number: 1.8004.518

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

320 – AL Timing Cylinder B10

ZKP-Number: 1.8004.519

Cause	Corrective action
Time-of-flight measuring fault of injector: time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 119).

321 – AL Wiring Cylinder A1

ZKP-Number: 1.8004.520

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

322 – AL Wiring Cylinder A2

ZKP-Number: 1.8004.521

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

323 – AL Wiring Cylinder A3

ZKP-Number: 1.8004.522

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

TIM-ID: 0000008506 - 001

324 – AL Wiring Cylinder A4

ZKP-Number: 1.8004.523

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

325 – AL Wiring Cylinder A5

ZKP-Number: 1.8004.524

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

326 – AL Wiring Cylinder A6

ZKP-Number: 1.8004.525

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

327 – AL Wiring Cylinder A7

ZKP-Number: 1.8004.526

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

328 – AL Wiring Cylinder A8

ZKP-Number: 1.8004.527

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

329 – AL Wiring Cylinder A9

ZKP-Number: 1.8004.528

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

330 – AL Wiring Cylinder A10

ZKP-Number: 1.8004.529

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

TIM-ID: 0000008506 - 001

331 – AL Wiring Cylinder B1

ZKP-Number: 1.8004.530

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

332 – AL Wiring Cylinder B2

ZKP-Number: 1.8004.531

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

333 – AL Wiring Cylinder B3

ZKP-Number: 1.8004.532

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

334 – AL Wiring Cylinder B4

ZKP-Number: 1.8004.533

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

335 – AL Wiring Cylinder B5

ZKP-Number: 1.8004.534

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

336 – AL Wiring Cylinder B6

ZKP-Number: 1.8004.535

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

337 – AL Wiring Cylinder B7

ZKP-Number: 1.8004.536

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

TIM-ID: 0000008506 - 001

338 – AL Wiring Cylinder B8

ZKP-Number: 1.8004.537

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

339 – AL Wiring Cylinder B9

ZKP-Number: 1.8004.538

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

340 – AL Wiring Cylinder B10

ZKP-Number: 1.8004.539

Cause	Corrective action
Cabling fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

341 – AL Open Load Cylinder A1

ZKP-Number: 1.8004.540

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

342 – AL Open Load Cylinder A2

ZKP-Number: 1.8004.541

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

343 – AL Open Load Cylinder A3

ZKP-Number: 1.8004.542

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

344 – AL Open Load Cylinder A4

ZKP-Number: 1.8004.543

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

TIM-ID: 0000008506 - 001

345 – AL Open Load Cylinder A5

ZKP-Number: 1.8004.544

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

346 – AL Open Load Cylinder A6

ZKP-Number: 1.8004.545

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

347 – AL Open Load Cylinder A7

ZKP-Number: 1.8004.546

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

348 – AL Open Load Cylinder A8

ZKP-Number: 1.8004.547

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

349 – AL Open Load Cylinder A9

ZKP-Number: 1.8004.548

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

350 – AL Open Load Cylinder A10

ZKP-Number: 1.8004.549

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

351 – AL Open Load Cylinder B1

ZKP-Number: 1.8004.550

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

TIM-ID: 0000008506 - 001

352 – AL Open Load Cylinder B2

ZKP-Number: 1.8004.551

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

353 – AL Open Load Cylinder B3

ZKP-Number: 1.8004.552

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

354 – AL Open Load Cylinder B4

ZKP-Number: 1.8004.553

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

355 – AL Open Load Cylinder B5

ZKP-Number: 1.8004.554

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

356 – AL Open Load Cylinder B6

ZKP-Number: 1.8004.555

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

357 – AL Open Load Cylinder B7

ZKP-Number: 1.8004.556

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

358 – AL Open Load Cylinder B8

ZKP-Number: 1.8004.557

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

TIM-ID: 0000008506 - 001

359 – AL Open Load Cylinder B9

ZKP-Number: 1.8004.558

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

360 – AL Open Load Cylinder B10

ZKP-Number: 1.8004.559

Cause	Corrective action
Disruption fault in injector cabling to cylinder. Result: misfiring.	1. Check solenoid valve. 2. Contact Service.

361 – AL Power Stage Low

ZKP-Number: 1.8004.496

Cause	Corrective action
Internal electronic fault (electronics possibly faulty: start ITS). If the ITS diagnosis result is “electronics OK”, note further fault messages (e.g. Cabling faults).	1. Check solenoid valve cabling. 2. Replace ECU.

362 – AL Power Stage High

ZKP-Number: 1.8004.497

Cause	Corrective action
Internal electronic fault (electronics possibly faulty: start ITS). If the ITS diagnosis result is “electronics OK”, note further fault messages (e.g. Cabling faults).	1. Check solenoid valve cabling. 2. Replace ECU.

363 – AL Stop Power Stage

ZKP-Number: 1.8004.560

Cause	Corrective action
Internal electronic fault (electronics possibly faulty: start ITS).	1. Check cabling. 2. Attempt to restart engine.

TIM-ID: 0000008506 - 001

365 – AL Stop MV-Wiring Ground

ZKP-Number: 1.8004.561

Cause	Corrective action
Injector cabling fault. If bit “1.1020.021” (Power Stage Failure: stop engine) is set, engine will be shut down as additional measure. 1. Short circuit of positive connection of one or more injectors to ground 2. Short circuit of negative connection of one or more injectors to ground .	1. Check cabling. 2. Attempt to restart engine.

371 – AL Wiring TO 1

ZKP-Number: 1.8004.634

Cause	Corrective action
Short circuit or wire break on transistor output 1 (TO 1).	1. Check turbocharger valve/cabling, repair as necessary. 2. Replace ECU.

372 – AL Wiring TO 2

ZKP-Number: 1.8004.635

Cause	Corrective action
Short circuit or wire break on transistor output 2 (TO 2).	1. Check recirculation valve/cabling, repair as necessary. 2. Replace ECU.

373 – AL Wiring TO 3

ZKP-Number: 1.8004.636

Cause	Corrective action
Short circuit or wire break on transistor output 3 (TO 3).	▶ -

374 – AL Wiring TO 4

ZKP-Number: 1.8004.637

Cause	Corrective action
Short circuit or wire break on transistor output 4 (TO 4).	▶ -

TIM-ID: 0000008506 - 001

381 – AL Wiring TOP 1

ZKP-Number: 2.8006.638

Cause	Corrective action
Short circuit or wire break on transistor output, plant-side 1 (TOP 1).	▶ Check cabling to plant.

382 – AL Wiring TOP 2

ZKP-Number: 2.8006.639

Cause	Corrective action
Short circuit or wire break on transistor output, plant-side 2 (TOP 2).	▶ Check cabling to plant.

383 – AL Wiring TOP 3

ZKP-Number: 2.8006.640

Cause	Corrective action
Short circuit or wire break on transistor output, plant-side 3 (TOP 3).	▶ Check cabling to plant.

384 – AL Wiring TOP 4

ZKP-Number: 2.8006.641

Cause	Corrective action
Short circuit or wire break on transistor output, plant-side 4 (TOP 4).	▶ Check cabling to plant.

390 – AL MCR exceeded

ZKP-Number: 1.1085.009

Cause	Corrective action
DBR/MCR function: MCR has been exceeded.	1. If alarm is only temporary, no action required; 2. if alarm is continuously active, contact Service.

392 – HI T-Coolant Red

ZKP-Number: 2.0129.931

Limit value 1

Cause	Corrective action
Redundant coolant temperature reading too high.	1. Check cabling. 2. Contact Service.

TIM-ID: 0000008506 - 001

393 – SS T-Coolant Red

ZKP-Number: 2.0129.932

Limit value 2

Cause	Corrective action
Redundant coolant temperature reading too high; engine shutdown.	1. Check cabling and sensor. 2. Contact Service.

394 – LO P-Lube Oil Red

ZKP-Number: 2.0112.921

Limit value 1

Cause	Corrective action
Redundant lube oil pressure reading too low.	1. Check cabling and sensor. 2. Contact Service.

395 – SS P-Lube Oil Red

ZKP-Number: 2.0112.922

Limit value 2

Cause	Corrective action
Redundant lube oil pressure reading too low.	1. Check cabling and sensor. 2. Contact Service.

396 – TD T-Coolant Sensor Deviation

ZKP-Number: 1.0480.193

Cause	Corrective action
Maximum coolant temperature deviation.	1. Check cabling and sensor. 2. Contact Service.

397 – TD P-Oil Sensor Deviation

ZKP-Number: 1.0480.293

Cause	Corrective action
Maximum lube oil pressure deviation.	1. Check cabling and sensor. 2. Contact Service.

400 – AL Open Load Digital Input 1

ZKP-Number: 2.8006.625

Cause	Corrective action
Open circuit at digital input 1; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

TIM-ID: 0000008506 - 001

401 – AL Open Load Digital Input 2

ZKP-Number: 2.8006.626

Cause	Corrective action
Open circuit at digital input 2; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

402 – AL Open Load Digital Input 3

ZKP-Number: 2.8006.627

Cause	Corrective action
Open circuit at digital input 3; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

403 – AL Open Load Digital Input 4

ZKP-Number: 2.8006.628

Cause	Corrective action
Open circuit at digital input 4; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

404 – AL Open Load Digital Input 5

ZKP-Number: 2.8006.629

Cause	Corrective action
Open circuit at digital input 5; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

405 – AL Open Load Digital Input 6

ZKP-Number: 2.8006.630

Cause	Corrective action
Open circuit at digital input 6; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

406 – AL Open Load Digital Input 7

ZKP-Number: 2.8006.631

Cause	Corrective action
Open circuit at digital input 7; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

TIM-ID: 0000008506 - 001

407 – AL Open Load Digital Input 8

ZKP-Number: 2.8006.632

Cause	Corrective action
Open circuit at digital input 8; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

408 – AL Open Load Emerg. Stop Input ESI

ZKP-Number: 2.8006.633

Cause	Corrective action
Open circuit at input for emergency stop; cabling faulty or no resistance across the switch.	1. Check cabling. 2. Check input of target device. 3. Contact Service.

410 – LO U-PDU

ZKP-Number: 2.0141.921

Limit value 1

Cause	Corrective action
Injector voltage too low.	1. Check cabling. 2. Check power supply. 3. Contact Service.

411 – LOLO U-PDU

ZKP-Number: 2.0141.922

Limit value 2

Cause	Corrective action
Injector voltage too low.	1. Check cabling. 2. Check power supply. 3. Contact Service.

412 – HI U-PDU

ZKP-Number: 2.0141.931

Limit value 1

Cause	Corrective action
Injector voltage too high.	1. Check cabling. 2. Check power supply. 3. Contact Service.

TIM-ID: 0000008506 - 001

413 – HIHI U-PDU

ZKP-Number: 2.0141.932

Limit value 2

Cause	Corrective action
Injector voltage too high.	1. Check cabling. 2. Check power supply. 3. Contact Service.

414 – HI Water Level Fuel Prefilter

ZKP-Number: 2.0156.931

Limit value 1

Cause	Corrective action
Water level in fuel prefilter too high.	▶ Drain water (→ Page 129).

415 – LO P-Coolant Intercooler

ZKP-Number: 2.0107.921

Limit value 1

Cause	Corrective action
Coolant pressure in intercooler too low.	▶ Top up coolant (→ Page 158).

416 – SS P-Coolant Intercooler

ZKP-Number: 2.0107.922

Limit value 2

Cause	Corrective action
Coolant pressure in intercooler too low; engine shutdown.	▶ Top up coolant (→ Page 158).

417 – SD Water Level Fuel Prefilter

ZKP-Number: 1.8004.594

Cause	Corrective action
Water level sensor of fuel prefilter faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

419 – SD T-Coolant b.Engine

ZKP-Number: 18.004.604

Cause	Corrective action
Coolant inlet temperature sensor faulty, short circuit or wire break.	▶ Check sensor and cabling (B3), replace as necessary.

TIM-ID: 0000008506 - 001

420 – AL L1 Aux 1

ZKP-Number: 2.0160.921

Limit value 1

Cause	Corrective action
Input signal of Aux 1 has exceeded/not attained limit value 1, depending on configuration.	▶ Determine and rectify reason for limit value violation.

421 – AL L2 Aux 1

ZKP-Number: 2.0160.922

Limit value 2

Cause	Corrective action
Input signal of Aux 1 has exceeded/not attained limit value 2, depending on configuration.	▶ Determine and rectify reason for limit value violation.

428 – AL L1 T-Aux 1

ZKP-Number: 2.0130.921

Limit value 1

Cause	Corrective action
Temperature signal of Aux 1 has exceeded / not attained limit value 1, depending on configuration.	▶ Determine and rectify reason for limit value violation.

430 – LO P-Coolant before Engine

ZKP-Number: 20.168.921

Limit value 1

Cause	Corrective action
Coolant pressure too low.	▶ Check coolant circuit.

431 – SS P-Coolant before Engine

ZKP-Number: 20.168.922

Limit value 2

Cause	Corrective action
Coolant pressure too low.	▶ Check coolant circuit.

TIM-ID: 0000008506 - 001

434 – HI T-Coolant before Engine

ZKP-Number: 20.173.931

Limit value 1

Cause	Corrective action
Coolant temperature too high.	▶ Check coolant circuit.

435 – SS T-Coolant before Engine

ZKP-Number: 20.173.932

Limit value 2

Cause	Corrective action
Coolant temperature too high.	▶ Check coolant circuit.

440 – AL L1 P-Aux 1

ZKP-Number: 2.0110.921

Limit value 1

Cause	Corrective action
Pressure signal of Aux 1 has exceeded / not attained limit value 1, depending on configuration.	▶ Determine and rectify reason for limit value violation.

442 – AL L2 P-Aux 1

ZKP-Number: 2.0110.931

Limit value 2

Cause	Corrective action
Pressure signal of Aux 1 has exceeded / not attained limit value 2, depending on configuration.	▶ Determine and rectify reason for limit value violation.

444 – SD U-PDU

ZKP-Number: 1.8004.578

Cause	Corrective action
Sensor defect of injector power stage; internal fault of engine governor.	▶ Replace ECU.

445 – SD P-Ambient Air

ZKP-Number: 1.8004.580

Cause	Corrective action
ambient air pressure sensor faulty.	▶ Replace ECU.

TIM-ID: 0000008506 - 001

448 – HI P-Charge Air

ZKP-Number: 2.0103.931

Limit value 1

Cause	Corrective action
Charge-air pressure too high.	▶ Contact Service.

449 – SS P-Charge Air

ZKP-Number: 2.0103.932

Limit value 2

Cause	Corrective action
Charge-air pressure too high.	▶ Contact Service.

450 – SD Idle/End-Torque Input [%]

ZKP-Number: 2.8006.592

Cause	Corrective action
Input signal for idle/end torque faulty; short circuit or wire break.	▶ Check signal transmitter and cabling, replace as necessary. Error cleared after restarting the engine.

454 – SS Power Reduction Active

ZKP-Number: 2.7000.011

Cause	Corrective action
Power reduction is active.	1. Note further fault messages. 2. Determine and rectify reason for power reduction.

455 – AL L1 Aux1 Plant

ZKP-Number: 2.8006.650

Limit value 1

Cause	Corrective action
Input signal of Aux 1 (plant side) has exceeded/not attained limit value 1, depending on configuration.	▶ Determine and rectify reason for limit value violation.

456 – AL L2 Aux1 Plant

ZKP-Number: 2.8006.651

Limit value 2

Cause	Corrective action
Input signal of Aux 1 (plant side) has exceeded/not attained limit value 2, depending on configuration.	▶ Determine and rectify reason for limit value violation.

TIM-ID: 0000008506 - 001

460 – HI T-Exhaust EMU

ZKP-Number: 2.8006.652

Limit value 1

Cause	Corrective action
EMU exhaust gas temperature value too high.	1. Check cabling. 2. Contact Service.

461 – LO T-Exhaust EMU

ZKP-Number: 2.8006.653

Limit value 1

Cause	Corrective action
EMU exhaust gas temperature value too low.	1. Check cabling. 2. Contact Service.

462 – HI T-Coolant EMU

ZKP-Number: 2.8006.654

Limit value 1

Cause	Corrective action
EMU coolant temperature value too high / low.	▶ Check configuration with DiaSys.

464 – SD P-AUX 1

ZKP-Number: 1.8004.589

Cause	Corrective action
Analog pressure input signal for Aux 1 faulty; short circuit or wire break.	▶ Check pressure transmitter and cabling, replace as necessary. Error cleared after restarting the engine.

467 – AL L2 T-Aux 1

ZKP-Number: 2.0130.922

Limit value 2

Cause	Corrective action
Temperature signal of Aux 1 has exceeded / not attained limit value 2, depending on configuration.	▶ Determine and rectify reason for limit value violation.

468 – SD T-AUX 1

ZKP-Number: 1.8004.579

Cause	Corrective action
Analog input for Aux 1 temperature faulty.	▶ Replace ECU.

TIM-ID: 0000008506 - 001

469 – SD AUX 1

ZKP-Number: 1.8004.590

Cause	Corrective action
Analog input signal for Aux 1 faulty; short circuit or wire break.	▶ Check signal transmitter and cabling, replace as necessary. Error cleared after restarting the engine.

470 – SD T-ECU

ZKP-Number: 1.8004.587

Cause	Corrective action
Temperature sensor for ECU faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

471 – SD Coil Current

ZKP-Number: 1.8004.592

Cause	Corrective action
Control circuit for suction restrictor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

472 – AI Stop SD

ZKP-Number: 2.8006.593

Cause	Corrective action
Engine shutdown, since all shutdown channels have “sensor faulty”.	1. Check cabling. 2. Contact Service.

473 – AL Cabling PWM_CM2

ZKP-Number: 1.8004.593

Cause	Corrective action
Cable break or short circuit on channel PWM_CM2.	1. Check cabling. 2. Contact Service.

474 – AL Wiring FO

ZKP-Number: 2.8006.655

Cause	Corrective action
Cable break or short circuit on channel FO.	1. Check cabling. 2. Contact Service.

TIM-ID: 0000008506 - 001

475 – AL CR Trigger Engine Stop

ZKP-Number: 1.8010.009

Cause	Corrective action
Tripped by crash recorder triggering due to engine shutdown.	▶ Determine and rectify cause of triggering / engine shutdown.

476 – AL Crash Rec. Init. Error

ZKP-Number: 1.8010.007

Cause	Corrective action
Crash recorder initialization error.	▶ Check setting with DiaSys.

478 – AL Comb. Alarm Yel (Plant)

ZKP-Number: 2.8006.001

Cause	Corrective action
Combined alarm YELLOW from plant.	▶ Note further fault messages.

479 – AL Comb. Alarm Red (Plant)

ZKP-Number: 2.8006.002

Cause	Corrective action
Combined alarm RED from plant.	▶ Note further fault messages.

480 – AL Ext. Engine Protection

ZKP-Number: 20.291.921

Cause	Corrective action
External engine protection function is active.	▶ Monitoring of plant signal by ECU is active (plant-side). Check plant signal.

482 – SD T-Exhaust C

ZKP-Number: 18.004.596

Cause	Corrective action
Exhaust temperature sensor on A-side faulty; short circuit or wire break.	▶ Check sensor and cabling (B4.23), replace as necessary.

TIM-ID: 0000008506 - 001

483 – SD T-Exhaust D

ZKP-Number: 18.004.597

Cause	Corrective action
Exhaust temperature sensor on A-side faulty; short circuit or wire break.	▶ Check sensor and cabling (B4.24), replace as necessary.

484 – HI T-Exhaust C

ZKP-Number: 20.133.931

Limit value 1

Cause	Corrective action
Exhaust gas temperature (C-side) too high.	1. Reduce power. 2. Contact Service.

485 – SS T-Exhaust C

ZKP-Number: 20.133.932

Limit value 2

Cause	Corrective action
Exhaust gas temperature (C-side) too high.	1. Reduce power. 2. Contact Service.

486 – HI T-Exhaust D

ZKP-Number: 20.134.931

Limit value 1

Cause	Corrective action
Exhaust gas temperature (D-side) too high.	1. Reduce power. 2. Contact Service.

487 – SS T-Exhaust D

ZKP-Number: 20.134.932

Limit value 2

Cause	Corrective action
Exhaust gas temperature (D-side) too high.	1. Reduce power. 2. Contact Service.

488 – HI ETC3 Overspeed

ZKP-Number: 23.014.931

Limit value 1

Cause	Corrective action
Speed of second secondary turbocharger too high.	▶ Reduce power.

TIM-ID: 0000008506 - 001

489 – SS ETC3 Overspeed

ZKP-Number: 23.014.932

Limit value 2

Cause	Corrective action
Speed of second secondary turbocharger too high.	▶ Reduce power.

490 – HI ETC4 Overspeed

ZKP-Number: 23.015.931

Limit value 1

Cause	Corrective action
Speed of third secondary turbocharger too high.	▶ Reduce power.

491 – SS ETC4 Overspeed

ZKP-Number: 23.015.932

Limit value 2

Cause	Corrective action
Speed of third secondary turbocharger too high.	▶ Reduce power.

492 – AL ETC4 CutIn Failure

ZKP-Number: 18.004.202

Cause	Corrective action
ETC 4 failed to cut in.	▶ Check control valve on turbocharger 4.

493 – AL ETC3 CutIn Failure

ZKP-Number: 18.004.203

Cause	Corrective action
ETC 3 failed to cut in.	▶ Check control valve on turbocharger 3.

500 – AL Wiring POM Starter 1

ZKP-Number: 14.500.900

Cause	Corrective action
A wiring fault was detected in the connection of starter 1 of the CPM. The root cause might be a missing consumer, a wire break or a short circuit.	▶ Check connection between POM and starter.

TIM-ID: 0000008506 - 001

501 – AL Wiring POM Starter 2

ZKP-Number: 14.500.901

Cause	Corrective action
A wiring fault was detected in the connection of starter 2 of the CPM. The root cause might be a missing consumer, a wire break or a short circuit.	▶ Check connection between POM and starter.

502 – AL Open Load POM Alternator

ZKP-Number: 14.500.902

Cause	Corrective action
An open circuit was detected at the battery-charging generator connection of the POM.	▶ Check connection between POM and battery-charging generator.

503 – AL Battery Not Charging

ZKP-Number: 14.500.903

Cause	Corrective action
Battery-charging generator does not charge the battery.	▶ Check battery-charging generator and cabling.

504 – AL CAN POM Node Lost

ZKP-Number: 14.500.904

Cause	Corrective action
POM missing on CAN bus.	▶ Check connection and POM.

506 – AL Low Starter Voltage

ZKP-Number: 14.500.906

Cause	Corrective action
Battery voltage too low for starting sequence.	▶ Check starter battery and cabling.

507 – AL POM Error

ZKP-Number: 14.500.907

Cause	Corrective action
A general POM error occurred.	▶ Replace POM.

TIM-ID: 000000506 - 001

508 – AL Wrong POM-ID

ZKP-Number: 14.500.908

Cause	Corrective action
POM transmits a different ID No. than expected.	▶ Check POM wiring harness.

510 – AL Override applied

ZKP-Number: 27.002.010

Cause	Corrective action
Override was activated.	▶ Deactivate Override pushbutton.

515 – AL Starter Not Engaged

ZKP-Number: 21.090.926

Cause	Corrective action
Starter on CPM / POM could not be engaged.The starting sequence will be terminated when the number of automatic start attempts defined in PR 2.1090.134 is exhausted. Check CPM, starter and cabling.	1. Repeat starting attempt 2. Check CPM, starter and cabling.

519 – Oilniveau Calibration Error

ZKP-Number: 10.158.921

Cause	Corrective action
Error when writing the calibration value to flash memory or level sensor defect.	1. Check sensor and cabling, replace as necessary. 2. Contact Service.

521 – SS P-Lube Oil Mid Val

ZKP-Number: 20.480.289

Limit value 1

Cause	Corrective action
Average oil pressure value from three sources is too low.	▶ Check oil level, top up as necessary .

523 – SS T-Coolant Red Mid Val

ZKP-Number: 20.480.189

Limit value 2

Cause	Corrective action
Average coolant temperature value from three sources is too high.	▶ Reduce power.

TIM-ID: 0000008506 - 001

524 – SS Engine Overspeed Mid Val

ZKP-Number: 20.480.089

Limit value 2

Cause	Corrective action
Average engine overspeed value from three sources is too high.	1. Acknowledge alarm. 2. Attempt to restart engine.

525 – SD P-Lube Oil (R2)

ZKP-Number: 18.004.638

Cause	Corrective action
Redundant lube oil pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

526 – SD T-Coolant (R2)

ZKP-Number: 18.004.639

Cause	Corrective action
Redundant coolant temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

527 – D EngineSpd. Sensor Deviation

ZKP-Number: 10.480.093

Cause	Corrective action
Maximum deviation of speed sensors	1. Check cabling of speed sensors. 2. Check for additional messages. 3. Contact Service.

528 – SD Engine Speed 3rd Sensor

ZKP-Number: 12.500.102

Cause	Corrective action
Redundant crankshaft speed sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

529 – SS T-Coolant Red2

ZKP-Number: 20.480.195

Limit value 2

Cause	Corrective action
Second redundant coolant temperature too high.	▶ Check coolant circuit.

TIM-ID: 0000008506 - 001

530 – SS P-Lube Oil Red2

ZKP-Number: 20.480.295

Limit value 2

Cause	Corrective action
Second redundant lube-oil pressure too high.	▶ Check oil level, top up as necessary .

543 – AL Multiple FDH Slaves

ZKP-Number: 20.555.005

Cause	Corrective action
There is more than one unit activated as backup medium for FDH.	▶ Contact Service.

544 – AL Configuration Changed

ZKP-Number: 20.555.003

Cause	Corrective action
This alarm is activated if the system configuration was changed, e.g. due to an exchange of the ECU or SAM.	▶ This alarm remains active until either the process is made undone or data have been transferred due to an active maintenance job. The alarm will then be cleared automatically.

549 – AL Power Cut-Off detected

ZKP-Number: 27.001.952

This is an alarm from the emergency stop counting feature.

Cause	Corrective action
The ECU supply voltage was switched off while the engine was running. This may lead to excessive pressure in the HP fuel system which might cause damage to the engine.	▶ Instruct operators to disconnect power supply only when the engine is at standstill.

550 – SS Engine Overspeed Red2

ZKP-Number: 20.480.095

Limit value 2

Cause	Corrective action
Redundant engine overspeed.	1. Acknowledge alarm. 2. Attempt to restart engine.

TIM-ID: 0000008506 - 001

551 – SS Engine Overspeed Camshaft

ZKP-Number: 22.510.933

Limit value 2

Cause	Corrective action
Camshaft overspeed.	1. Acknowledge alarm. 2. Attempt to restart engine.

555 – AL Call MTU Field Service

ZKP-Number: 20.555.001

Cause	Corrective action
This alarm is activated if the ECU feature Field Data Handling (FDH) has carried out a maintenance job which led to a change of the engine parameters. This alarm will sty active even after switching the system off and on again until a valid activation code has been entered via the display and key control of the SAM. This activation code can be requested via internet according to a special procedure.	▶ Request activation code via internet.

576 – AL ESCM Override

ZKP-Number: 11.075.083

Cause	Corrective action
Corrected MCR or DBR/MCR curve was exceeded. Engine overload!	▶ Reduce power.

577 – SD T-Lube Oil Pan

ZKP-Number: 10.137.900

Cause	Corrective action
Temperature sensor in oil pan faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

578 – AL L1 T-Lube Oil Pan

ZKP-Number: 20.137.921

Limit value 1

Cause	Corrective action
L1 T-Lube Oil Pan has violated limit value 1.	▶

TIM-ID: 0000008506 - 001

579 – AL MD CAN Request Idle Speed

ZKP-Number: 21.063.511

Cause	Corrective action
MD forced idle demand => node failure (node 3,4 or 5)	▶

580 – AL MD CAN Speed Limitation

ZKP-Number: 21.063.513

Cause	Corrective action
MD speed limitation demand => node failure (node 3,4 or 5)	▶

581 – AL MD CAN Stop

ZKP-Number: 21.063.515

Cause	Corrective action
MD CAN stop demand => node failure (node 3,4 or 5)	▶

TIM-ID: 0000008506 - 001

6 Task Description

6.1 Engine

6.1.1 Engine – Barring manually

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

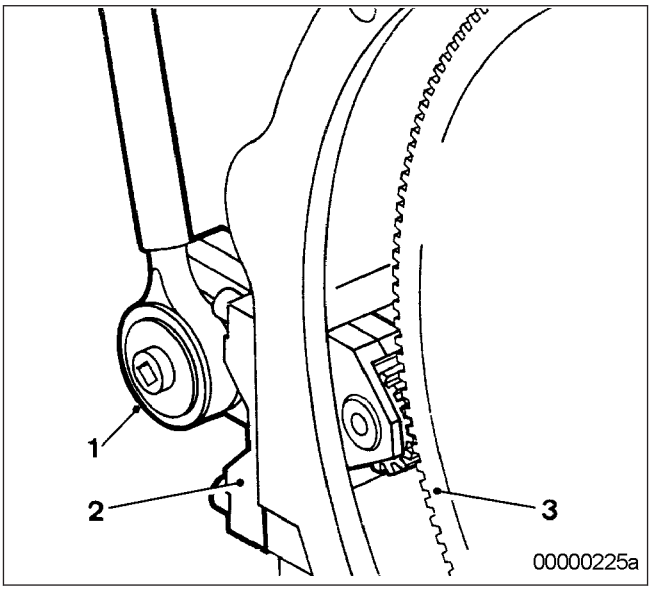
Designation / Use	Part No.	Qty.
Barring device	F6555766	1
Ratchet with extension	F30006212	1

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – Danger to life!
- Before barring the engine, ensure that nobody is in the danger zone.

Engine – Barring manually

1. Remove guard plate.
2. Engage barring device (2) with ring gear (3) and install on flywheel housing.
3. Place ratchet (1) onto barring device (2).
4. Rotate crankshaft in engine direction of rotation. Apart from the normal compression resistance, there should be no further resistance.
5. For barring device removal, follow reverse sequence of working steps.



TIM-ID: 0000000917 - 007

6.1.2 Engine – Barring with starting system

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- before barring or starting the engine, ensure that nobody is in the danger zone.
- After working on the engine, check that all protective devices have been reinstalled and all tools removed from the engine.

Engine – Barring with starting system

1. Release latch of connector X4.
2. Remove connector from engine governor.
3. Bar engine in unloaded condition: Press START button.
4. Let the crankshaft rotate until oil pressure is indicated.
5. Engine start is automatically interrupted when specified starting period has passed. If necessary, re-start the engine after approx. 20 seconds.
6. Connect connector X4 to engine governor and latch in position.

TIM-ID: 0000000918 - 004

6.1.3 Engine – Test run

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Engine – Test run

1. Start engine (→ Page 42).
2. Perform test run not below 1/3 load and at least until steady-state temperature is reached.
3. Carry out operational checks (→ Page 44).
4. Stop engine (→ Page 46).

TIM-ID: 0000000870 - 007

6.2 Cylinder Liner

6.2.1 Cylinder liner – Endoscopic examination

Preconditions

☑ Engine is stopped and starting disabled

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Rigid endoscope	Y20097353	1

Preparatory steps

1. Remove cylinder head cover (→ Page 117).
2. Remove injector (→ Page 120).

Positioning crankshaft at BDC

1. Using barring gear, turn crankshaft until crankshaft journal of the cylinder to be inspected has reached BDC.
2. Insert endoscope into cylinder liner through injector seat.

Endoscopic examination of cylinder liner

Findings	Action
• Thin carbon coating on circumference of carbon scraper ring • Slight localized additive deposits at top edge • Localized smooth areas on bottom edge • Carbon deposits on circumference in clearance between top piston ring and bottom edge of carbon scraper ring • First signs of marks left by top piston ring • Bright mark on entire circumference • Consistent honing pattern without objections • First signs of marks left by lower cooling bores • Running pattern seems darker	No action required
• Dark areas with even or varying degrees of discoloration • Beginning and end of the discoloration are not sharply defined and do not cover the entire stroke area • Dark areas in the upper section of the cooling bore, remaining circumference without objections • Piston rings without objections	Further endoscopic examination required as part of maintenance work
• On the entire circumference, apart from light areas of discoloration (that do not impair operation) clearly darker stripes that start at the top piston ring • Heat discoloration in the direction of stroke and honing pattern damage • Heat discoloration of piston rings	Cylinder liner must be replaced; Service must be contacted

1. Compile endoscopy report using the table.
2. Use technical terms for description of the liner surface (→ Page 109).
3. Depending on findings:
   - do not take any action or
   - carry out a further endoscopic examination as part of maintenance work or
   - contact Service; cylinder liner must be replaced.

TIM-ID: 0000000015 - 013

Final steps

1. Install injector (→ Page 120).
2. Install cylinder head cover (→ Page 117).

TIM-ID: 0000000015 - 013

6.2.2 Cylinder liner – Instructions and comments on endoscopic and visual examination

Terms used for endoscopic examination

Use the terms listed below to describe the condition of the cylinder-liner surface in the endoscopic examination report.

Findings	Measure
Minor dirt scores	Minor dirt scores can occur during the assembly of a new engine (honing products, particles, broken-off burrs). Removed cylinders clearly show such scoring on the running surface under endoscope magnification. Cannot be felt with the fingernail. Findings not critical.
Single scores	Clearly visible scores caused by hard particles. They usually start in the TDC area and cross through the hone pattern in the direction of stroke. Findings not critical.
Scored area	These areas consist of scores of different length and depth next to one another. In most cases, they are found at the 6-o'clock and 12-o'clock positions (inlet/exhaust) along the transverse engine axis. Findings not critical.
Smoothened area	Smoothened areas are on the running surface but almost the whole honing pattern is still visible. Smoothened areas appear brighter and more brilliant than the surrounding running surface. Findings not critical.
Bright area	Bright areas are on the running surface and show local removal of the honing pattern. Grooves from honing process are not visible any more.
Discoloration	This is caused by oxidation (surface discoloration through oil or fuel) and temperature differences around the liner. It appears rather darker within the honed structure in contrast to the bright metallic running surface. The honing pattern is undisturbed. Discolorations extend in stroke direction and may be interrupted. Findings not critical.
Corrosion fields / spots	Corrosion fields / spots result from water (condensed water) with the valves in the overlap (open) position. They are clearly visible due to the dark color of the honing groove bottom. This corrosion is not critical unless there is corrosion pitting.
Black lines	Black lines are a step towards heat discoloration. They are visible as a clear discoloration from TDC to BDC in the running surface and the start of localized damage to the honing pattern. Cylinder liners with a large number of black lines around the running surface have limited service life and should be replaced.

TIM-ID: 0000000014 - 013

Findings	Measure
Burn mark	This is caused by a malfunction in the liner / ring tribosystem. Usually they run over the whole ring-travel area (TDC/BDC), starting at the first TDC-ring and becoming more visible from the second TDC-ring 2 onwards and less pronounced from TDC-ring 1. The honing pattern is usually no longer visible and displays a clearly defined (straight) edge to the undisturbed surface. The damaged surface is usually discolored. The circumferential length varies. Liners with burn marks, or heat discoloration, starting in TDC ring 1 have to be replaced.
Seizure marks, scuffing	Irregular circumference lengths and depths. Can be caused either by the piston skirt or the piston crown. Material deposits on the liner (smear), heavy discoloration. Severe, visible scoring. Replace liner.

Evaluation of findings and further measures

The findings in the start phase of oxidation discoloration and heat discoloration are similar. A thorough investigation and compliance with the above evaluation criteria allow an unambiguous evaluation. To avoid unnecessary disassembly work, it is recommended that another inspection be carried out after further operation of the engine.

TIM-ID: 0000000014 - 013

6.3 Crankcase Breather

6.3.1 Crankcase breather – Oil mist fine separator replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

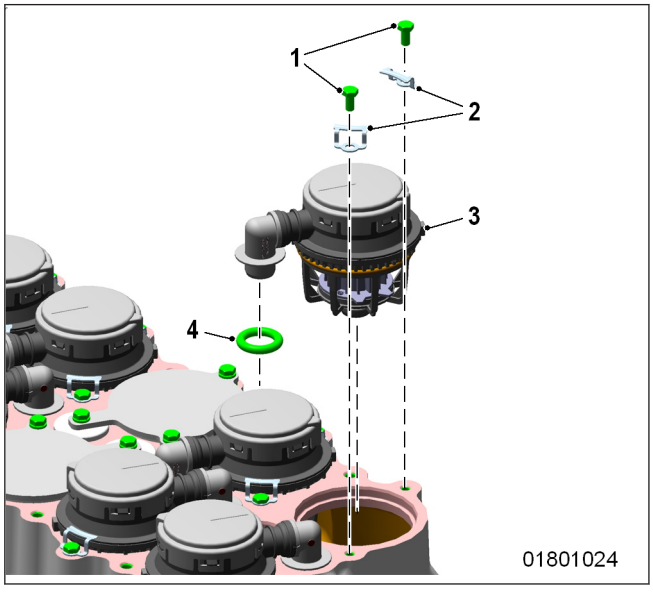
Designation / Use	Part No.	Qty.
Engine oil		
Oil mist fine separator	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Replacing oil mist fine separator

1. Loosen screws (1) and remove together with retainer (2).
2. Replace oil mist fine separator (3).
3. Check O-ring (4), replace if necessary.
4. Replace further oil mist fine separators in the same way.



TIM-ID: 0000018590 - 005

6.4 Valve Drive

6.4.1 Valve gear – Lubrication

Preconditions

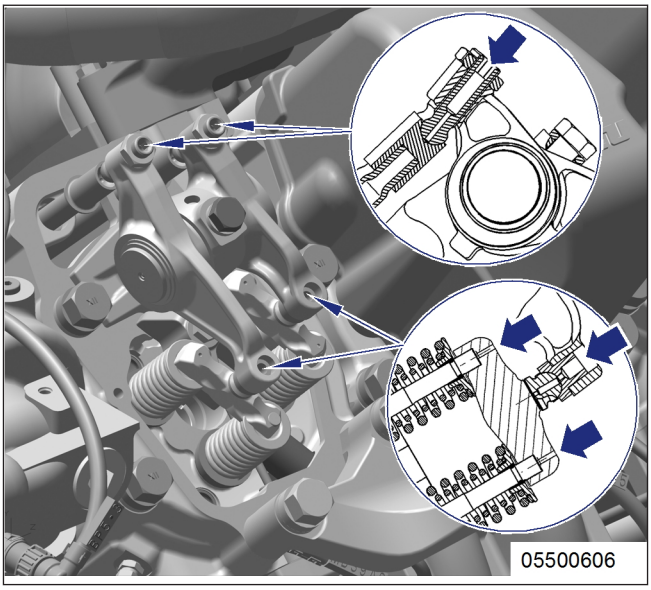
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

Valve gear – Lubrication

1. Remove cylinder head covers (→ Page 117).
2. Fill oil chambers of valve bridges with oil.
3. Fill oil chambers of rocker arms and adjusting screws with oil.
4. Install cylinder head covers (→ Page 117).



TIM-ID: 0000000921 - 008

6.4.2 Valve clearance – Check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine coolant temperature is max. 40 °C.

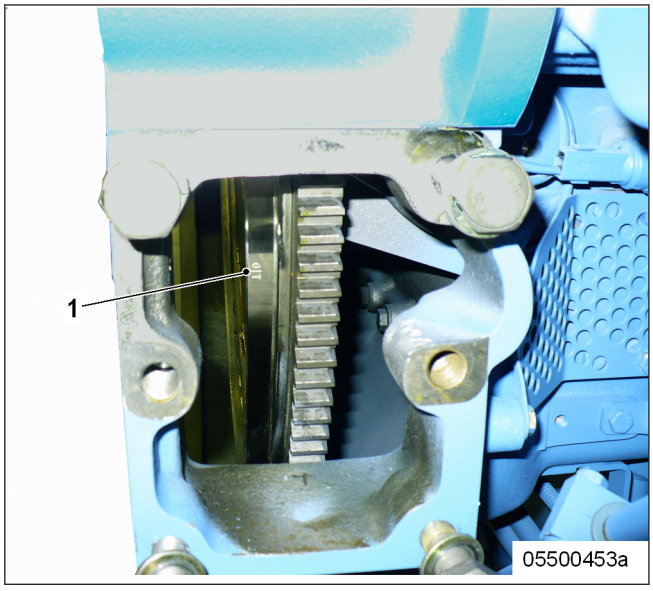
☑ Valves are closed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gauge	Y20098771	1
Torque wrench, 60-320 Nm	F30452768	1
Box wrench socket, 24 mm	F30039526	1
Ratchet adapter	F30027341	1
Engine oil		

Preparatory steps

1. Remove cylinder head cover (→ Page 117).
2. Install barring device (→ Page 104).
3. The TDC marking (1) (if fitted) on the flywheel must not be used for reference.



TIM-ID: 0000000922 - 008

4. Rotate crankshaft with barring device in direction of engine rotation until TDC-A1 marking and pointer are aligned.

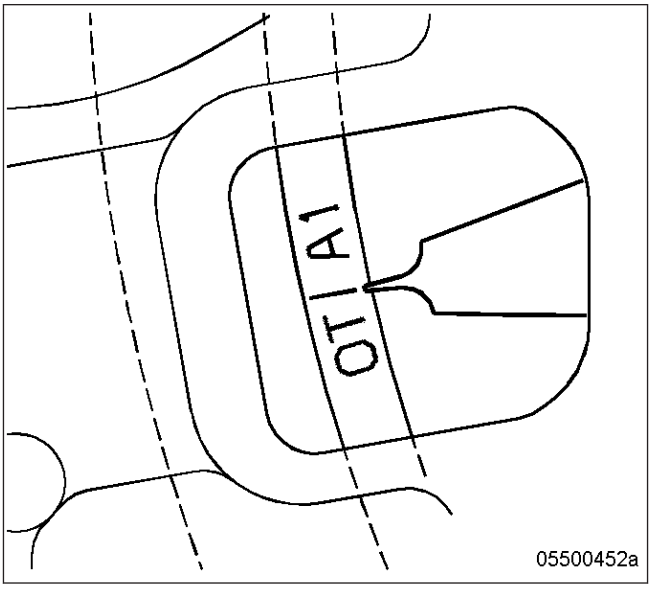


Diagram for 8V engines (two crankshaft positions)

1 Cylinder A1 is in firing TDC
2 Cylinder A1 is in overlap TDC
I Inlet valve
X Exhaust valve

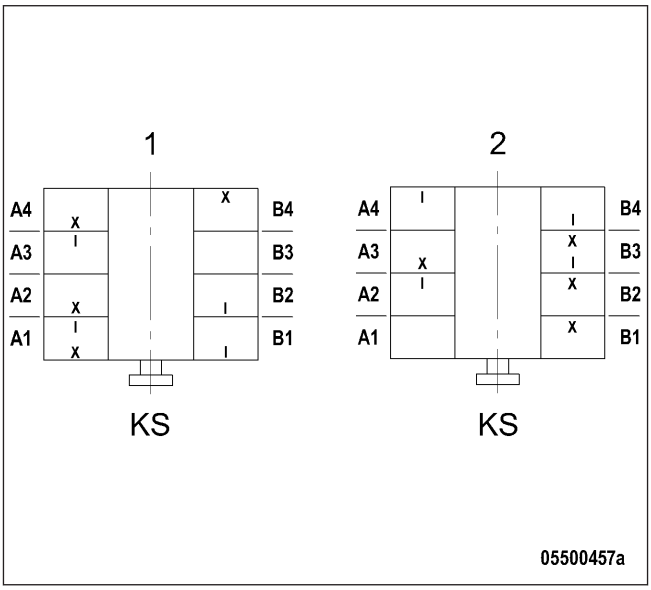
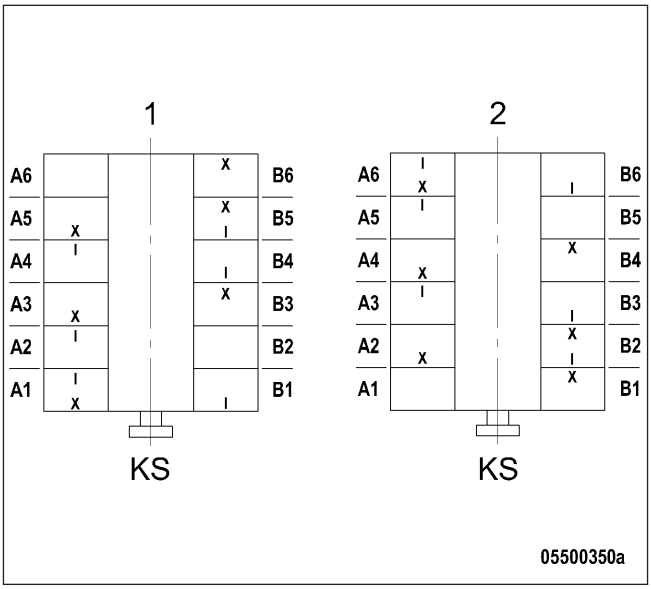


Diagram for 12V engines (two crankshaft positions)

1 Cylinder A1 is in firing TDC
2 Cylinder A1 is in overlap TDC
I Inlet valve
X Exhaust valve



TIM-ID: 0000000922 - 008

Diagram for 16V engines (two crankshaft positions)

1 Cylinder A1 is in firing TDC
2 Cylinder A1 is in overlap TDC
I Inlet valve
X Exhaust valve

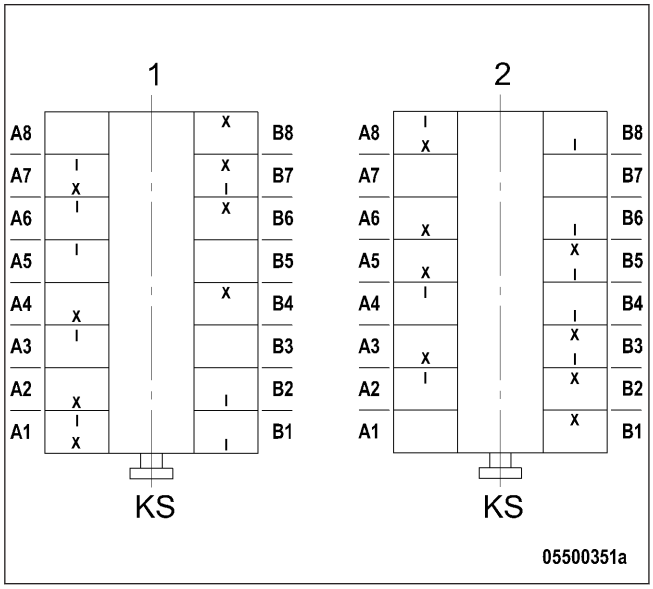
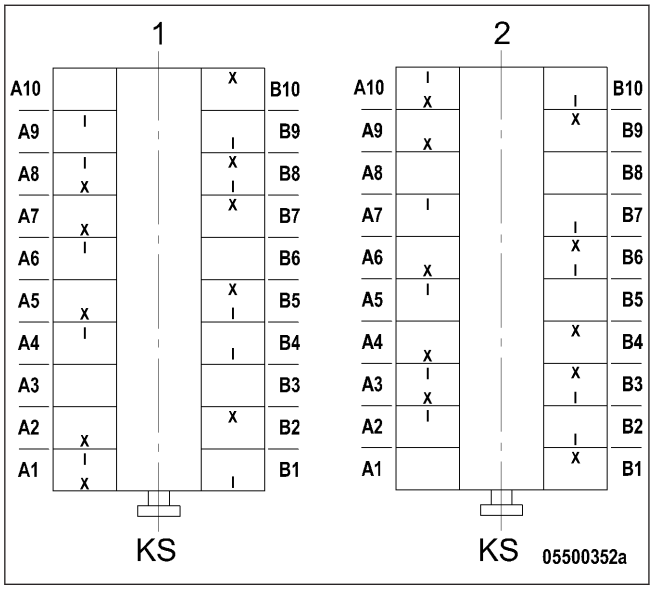


Diagram for 20V engines (two crankshaft positions)

1 Cylinder A1 is in firing TDC
2 Cylinder A1 is in overlap TDC
I Inlet valve
X Exhaust valve



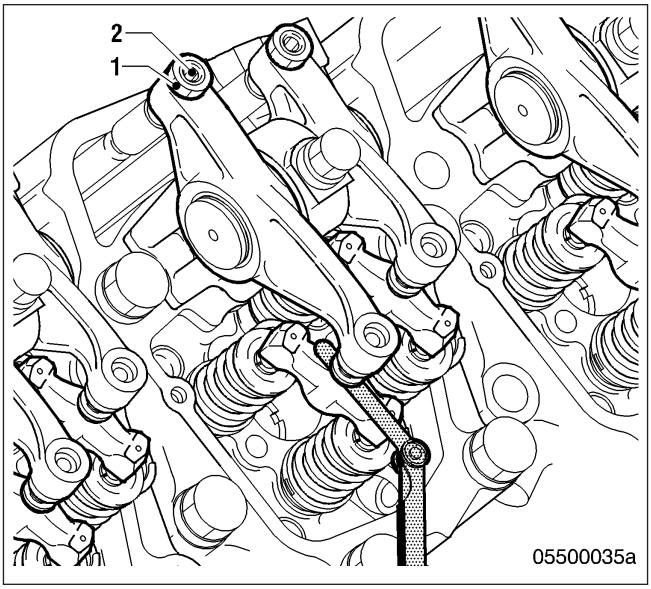
Checking valve clearance at two crankshaft positions

1. Check TDC position of piston in cylinder A1:
   - If the rocker arms are unloaded on cylinder A1, the piston is in firing TDC.
   - If the rocker arms are under load on cylinder A1, the piston is in overlap TDC.
2. Check valve clearance adjustment with cold engine:
   - Inlet (long rocker arm) = 0.2 mm
   - Exhaust (short rocker arm) = 0.5 mm
3. Check all valve clearances in two crankshaft positions (firing TDC and overlap TDC of cylinder A1) as per diagram.
4. Use feeler gauge to determine the distance between valve bridge and rocker arm.
5. If the deviation from the set value exceeds 0.1 mm, adjust valve clearance.

TIM-ID: 0000000922 - 008

Adjusting valve clearance

1. Release locknut (1).
2. Insert feeler gauge between valve bridge and rocker arm.
3. Use Allen key to set adjusting screw (2) so that the specified valve clearance is established.
4. Feeler gauge must just pass through the gap.



5. Tighten locknut (1) with torque wrench to the specified tightening torque, holding the adjusting screw (2) to prevent it from turning.

Name	Size	Type	Lubricant	Value/Standard
Locknut	M16 x 1.5	Tightening torque	(Engine oil)	90 Nm +9 Nm

6. Replace or rectify adjusting screws and/or locknuts which do not move freely.
7. Check valve clearance.

Final steps

1. Remove barring device (→ Page 104).
2. Install cylinder head cover (→ Page 117).

TIM-ID: 0000000922 - 008

6.4.3 Cylinder head cover – Removal and installation

Preconditions

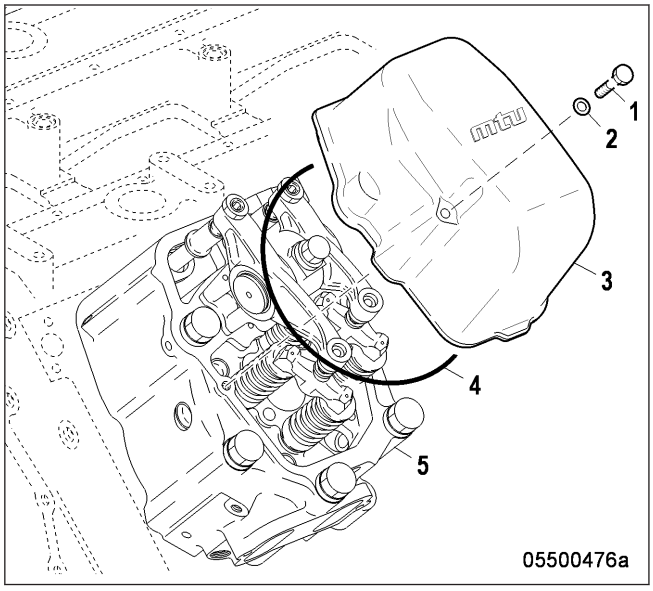
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Grease (Kluthe Hakuform 30-10/Emulgier)	X00058061	
O-ring	(→ Spare Parts Catalog)	

Removing cylinder head cover

1. Clean very dirty cylinder head covers (3) prior to removal.
2. Remove screws (1) and washers (2).
3. Take off cylinder head cover (3) with O-ring (4) from cylinder head (5).



Installing cylinder head cover

1. Clean mounting surface.
2. Check O-ring (4) for damage, replace if necessary.
3. Coat O-ring (4) with grease.
4. Position O-ring (4) in groove of cylinder head cover (3).
5. Fit cylinder head cover (3) on cylinder head (5).
6. Install cylinder head cover (3) with screws (1) and washers (2).

TIM-ID: 0000012309 - 007

6.5 Injection Pump / HP Pump

6.5.1 HP pump – Filling with engine oil

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

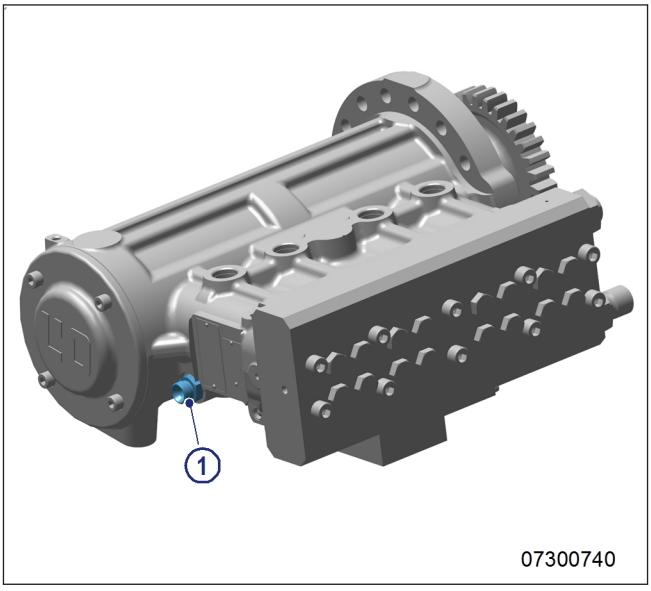
Oils/oil vapors are combustible.
Risk of fire!
- No open flames, no electric sparks. Do not smoke. Avoid ignition sources.

CAUTION

Fuel system high-pressure pump not filled with engine oil.
Damage to components, major material damage!
- Make sure that the high-pressure fuel pump is filled with engine oil before installation or initial operation.

Filling HP pump

1. Remove plug screw (1).
2. Use pump oiler to fill HP pump with engine oil until engine oil emerges.
3. Insert plug screw (1).



TIM-ID: 0000001640 - 009

6.6 Injection Valve / Injector

6.6.1 Injector – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Injector	(→ Spare Parts Catalog)	

Replacing injector

▶ Remove injector and install new injector (→ Page 120).

TIM-ID: 0000000022 - 013

6.6.2 Injector – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Installation/removal tool	F6789889	1
Milling cutter	F30452739	1
Torque wrench, 0.5-5 Nm	0015384230	1
Torque wrench, 10-60 Nm	F30452769	1
Torque wrench, 60-320 Nm	F30452768	1
Assembly paste (Optimoly Paste White T)	40477	1
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	1
Engine oil		
O-ring	(→ Spare Parts Catalog)	

WARNING

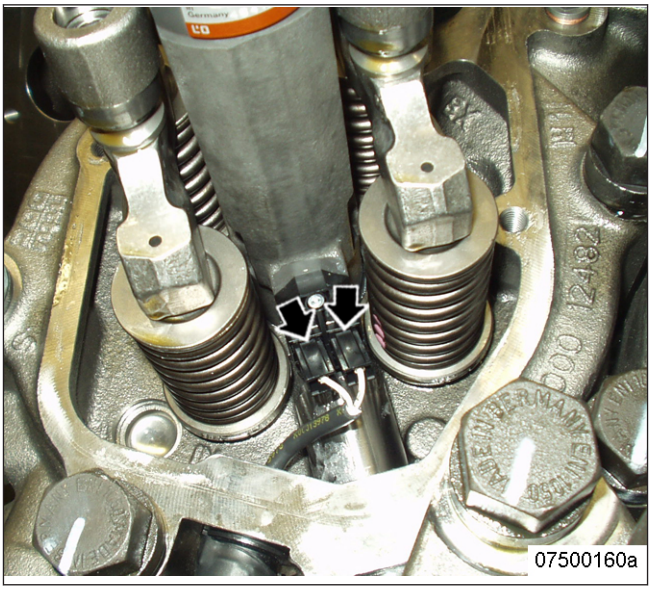
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Preparatory steps

1. Shut off fuel supply to engine.
2. Remove cylinder head cover (→ Page 117).

Removing injector

1. Disconnect cable connector on injector.

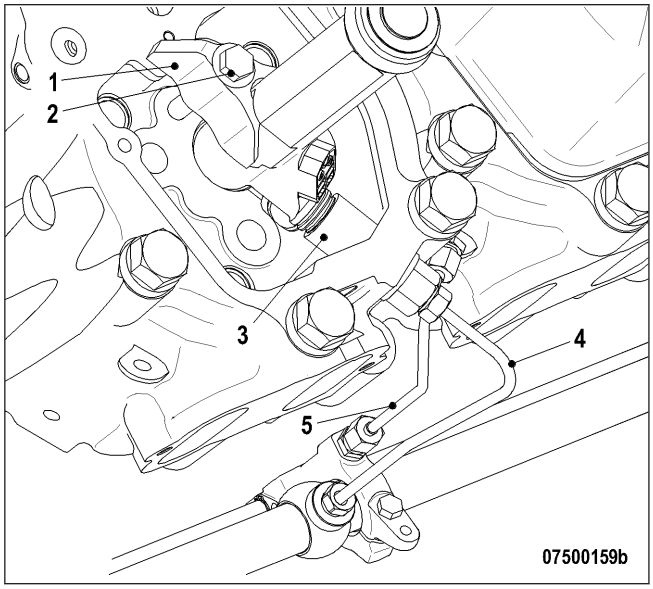


TIM-ID: 0000000925 - 006

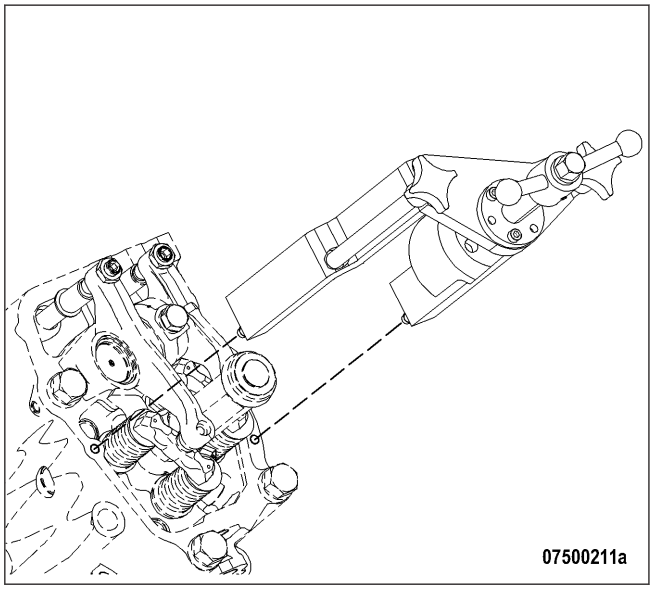
2. Remove HP fuel line (4).
3. Remove return line (5).

Note: The injector accumulator will be emptied when removing the adapter.

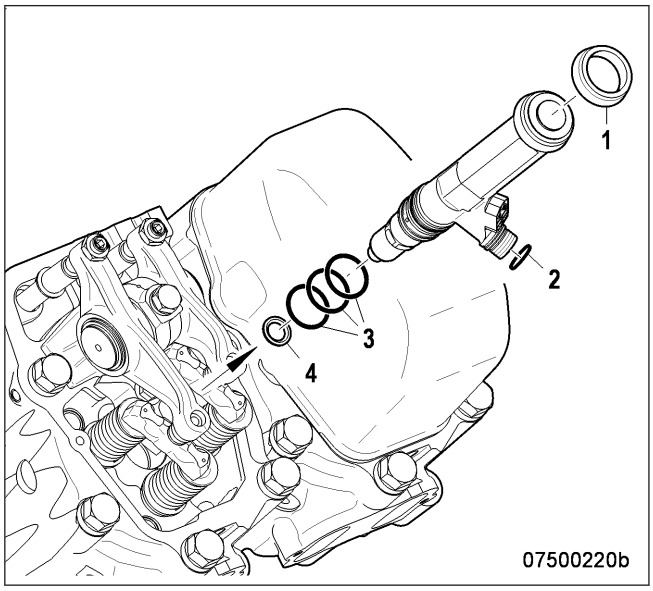
4. Remove adapter (3).
5. Remove screw (2) and take off hold-down clamp (1).



6. Install installation/removal tool on cylinder head.
7. Remove injector with installation/removal tool.
8. Remove installation/removal tool.



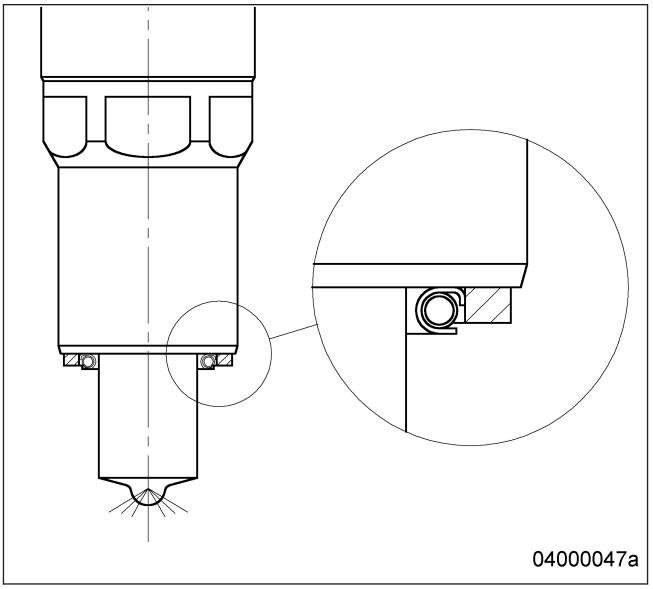
9. Remove sealing ring (4) from injector or use a self-made hook to take it out of the cylinder head.
10. Remove O-rings (3), O-ring (2) and damper ring (1) from injector.
11. Clean all mating and sealing surfaces.
12. Cover all connections and bores, or seal with suitable plugs.



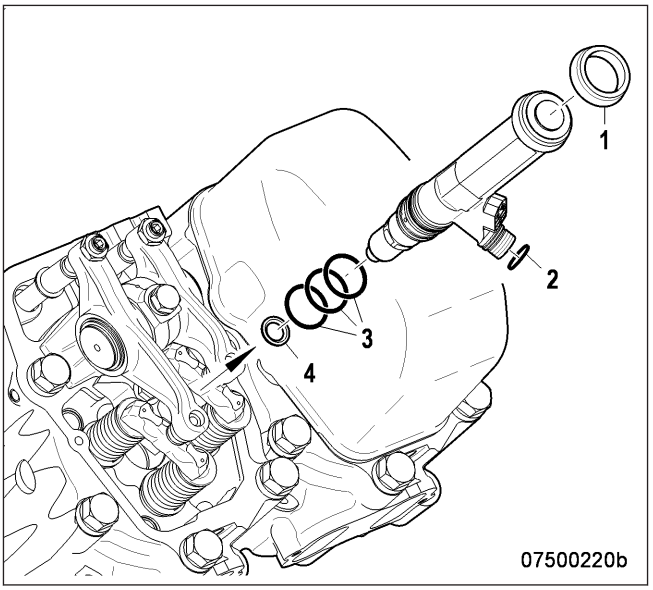
TIM-ID: 0000000925 - 006

Installing injector

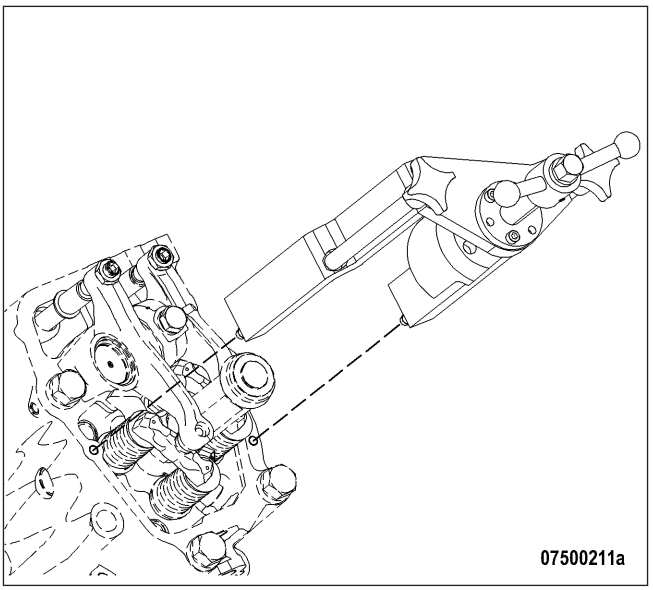
1. Remove plug before installing the injector. (Do not remove the plug from the HP line before installing the adapter.)
2. Coat injector with assembly paste at the seat of the nozzle clamping nut.
3. Fit new sealing ring (4) (included in the scope of supply of the injector) with grease on injector, observe installation position of sealing ring (4).



4. Fit new O-rings (3) (included in the scope of supply of the injector), O-ring (2) and damping ring (1) onto the injector and coat with grease.

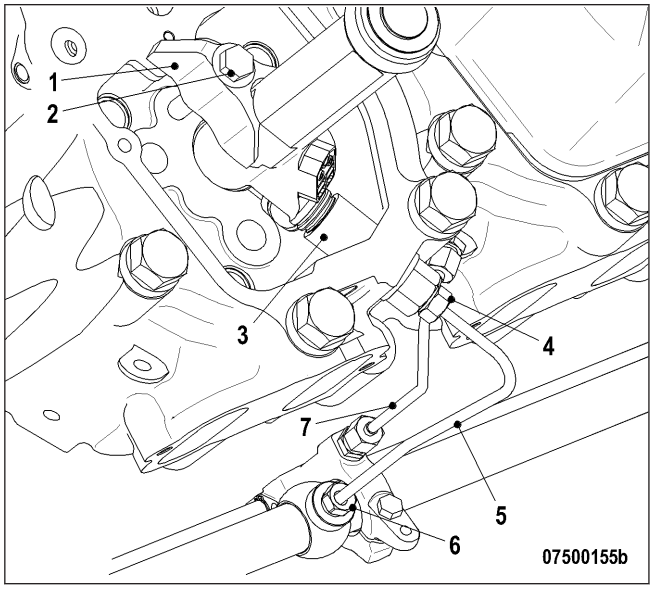


5. Clean sealing face on cylinder head and protective sleeve with milling cutter.
6. Insert injector into cylinder head, ensuring that the HP line adapter is correctly aligned.
7. Use installation/removal tool to press in injector.
8. Remove installation/removal tool.



TIM-ID: 0000000925 - 006

9. Coat screw head mating face (2) and thread with engine oil.



10. Fit hold-down clamp (1) in the correct position and use torque wrench to tighten screw (2) to the specified initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12	Preload torque	(Engine oil)	5 Nm to 10 Nm

Note: Ensure special cleanness.

11. Coat thread and sealing cone of adapter (3) with engine oil.

12. Install adapter (3) and use torque wrench to tighten to the specified initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Adapter		Preload torque	(Engine oil)	5 Nm to 10 Nm

13. Tighten screw (2) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12	Tightening torque		100 Nm + 10 Nm

14. Tighten adapter (3) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Adapter		Tightening torque		100 Nm + 10 Nm

15. Install return line (7).

Note: Ensure special cleanness.

16. Coat thread and sealing cone of HP line (5) with engine oil.

Note: Two HP line versions (single- and double-walled) with different torques as described below.

17. Mount single-walled HP line (5) and use torque wrench to tighten to the specified torque. Tightening sequence:
    1 Rail (6)
    2 Adapter (4)

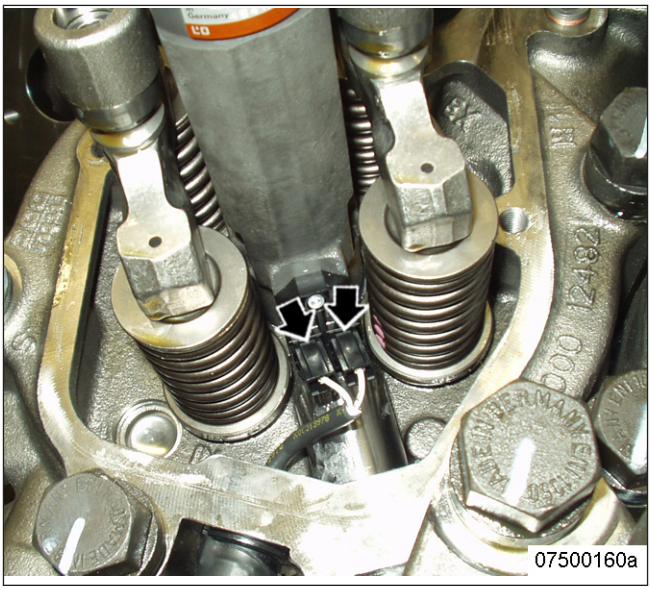
Name	Size	Type	Lubricant	Value/Standard
Union nut / thrust screw		Tightening torque		30 Nm + 5 Nm

TIM-ID: 0000000925 - 006

18. Mount double-walled HP line (5) and use torque wrench to tighten to the specified torque. Tightening sequence:
    1 Adapter (4)
    2 Rail (6)

Name	Size	Type	Lubricant	Value/Standard
Union nut / thrust screw		Tightening torque		40 Nm + 5 Nm

19. Fit cable connector onto injector.



Final steps

1. Install cylinder head cover (→ Page 117).
2. Open fuel supply to engine.

TIM-ID: 0000000925 - 006

6.7 Fuel System

6.7.1 Fuel system – Venting

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Diesel fuel		

WARNING

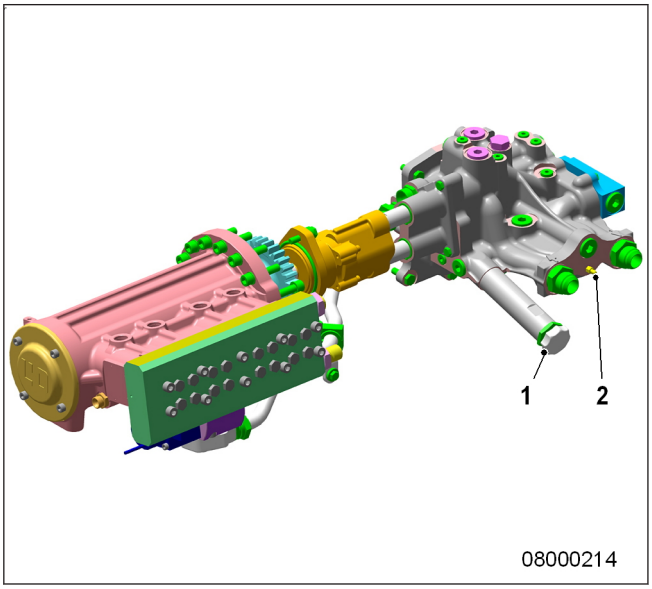
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Venting LP fuel system

1. Open the vent valve (2).
2. Fit transparent hose onto vent valve (2).
3. Unlock fuel priming pump (1), screw out handle by turning it anticlockwise.

Note: Collect fuel in a suitable container.

4. Operate the pump with the handle (1) until bubble-free fuel emerges from the vent valve (2).
5. Close vent valve (2).
6. Screw in handle (1) by turning it clockwise.
7. Remove hose from vent valve (2).
8. Verify that fuel priming pump (1) is locked: Handle must be tightened.



TIM-ID: 0000019572 - 001

6.8 Fuel Filter

6.8.1 Fuel filter – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

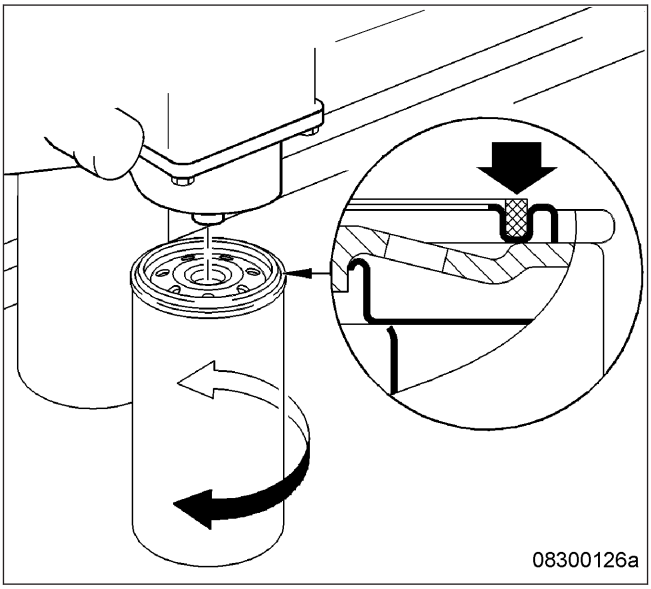
Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Engine oil		
Easy-change filter	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Replacing the fuel filter

1. Remove easy-change filter using filter wrench.
2. Clean the sealing face of the filter head.
3. Slightly lubricate seal on the easy-change filter.
4. Screw on the easy-change filter by hand until the seal makes contact and tighten finger-tight.
5. Replace other easy-change filters in the same way.
6. Vent the fuel system (→ Page 125).



TIM-ID: 0000004907 - 001

6.8.2 Fuel prefilter cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

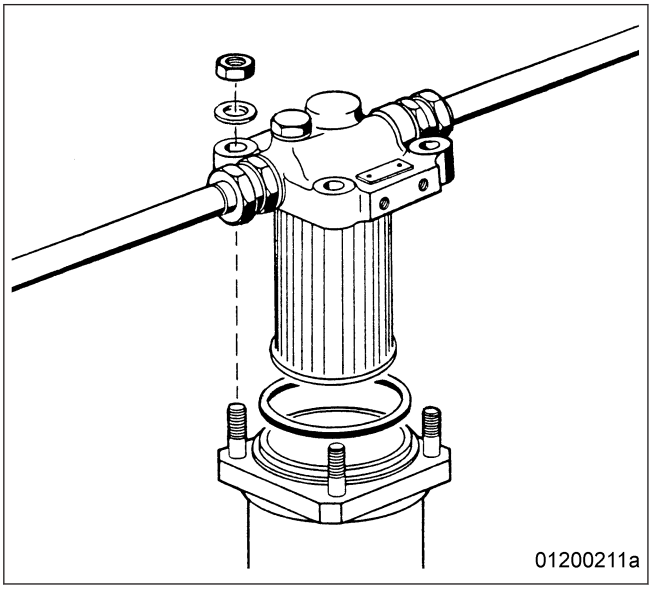
Designation / Use	Part No.	Qty.
Diesel fuel		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel prefilter cleaning

1. Shut off fuel supply.
2. Remove nuts from filter head.
3. Take off filter housing and drain fuel into appropriate container.
4. Remove filter-element securing nut and remove filter element by pulling it downwards.
5. Wash filter element in clean fuel using a smooth brush.
6. Wash filter housing with clean fuel.
7. Insert filter element into filter housing and secure with nut.
8. Place new sealing ring into groove in filter head.
9. Fit cover with seal and secure it with nuts crosswise.
10. Open fuel supply.



TIM-ID: 0000004936 - 001

6.8.3 Fuel prefilter – Differential pressure gauge check and adjustment

DANGER

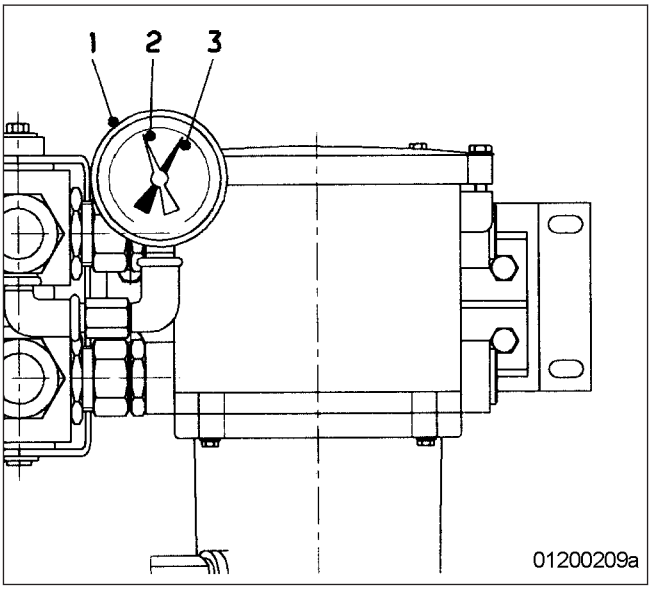
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Adjusting differential pressure gauge

1. When installing the new filter element: align adjustable pointer (2) with pressure-indicating pointer (3) of pressure gauge (1).
2. Check differential pressure.



Checking differential pressure of fuel prefilter

1. With the engine running at full load or rated power, read off pressure at gauge (1).
2. If differential pressure as indicated between position of adjustable pointer (2) and pressure-indicating pointer (3) of pressure gauge is ≥ 0.3 bar, flush filter element of the cut-in filter (→ Page 130).

TIM-ID: 0000004925 - 005

6.8.4 Fuel prefilter – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

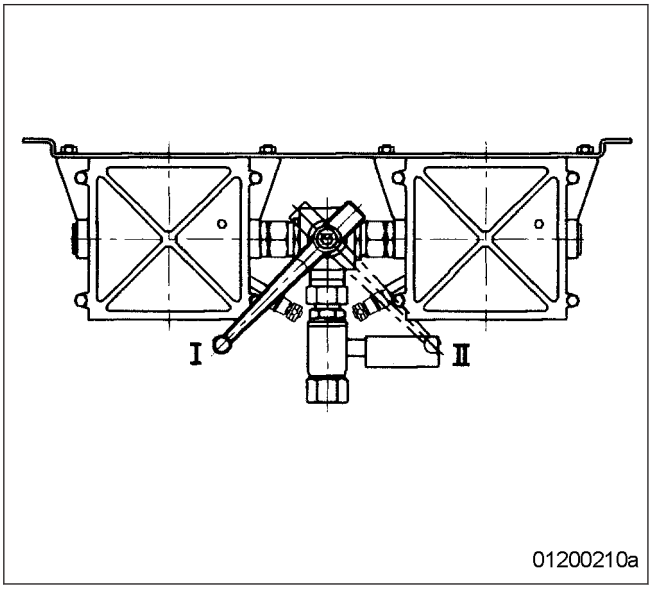
Designation / Use	Part No.	Qty.
Diesel fuel		
Gasket	(→ Spare Parts Catalog)	

WARNING

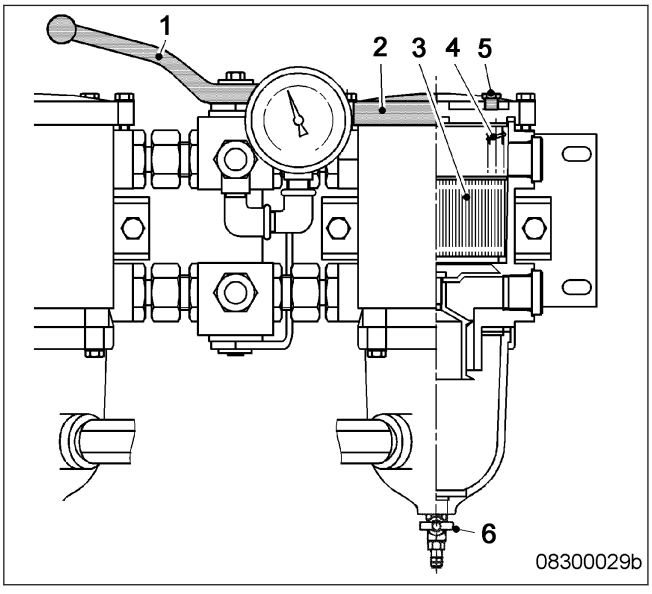
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel prefilter – Draining

1. Cut out filter to be drained.
   - I Left filter cut in
   - II Right filter cut in



2. Open threaded vent plug (5) of filter to be drained.
3. Unlock drain valve (6) by pressing toggle and open it.
4. Drain water and contaminants from filter until pure fuel emerges.
5. Close drain valve (6).
6. Remove screws for cover and take off cover (2).
7. Fill filter housing with clean fuel.
8. Place new gasket in cover (2).
9. Fit cover with gasket and secure it with screws.
10. Cut in the cut-out filter again.
11. Close threaded vent plug (5) when fuel emerges.



TIM-ID: 0000004929 - 003

6.8.5 Fuel prefilter – Flushing

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Fuel		
Gasket	(→ Spare Parts Catalog)	

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

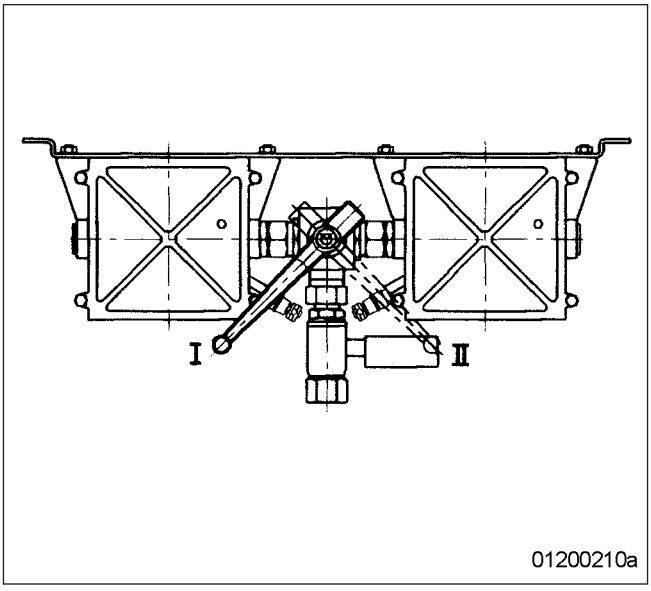
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Fuel prefilter – Flushing

1. Cut out clogged filter.
   - I Left filter cut in
   - II Right filter cut in

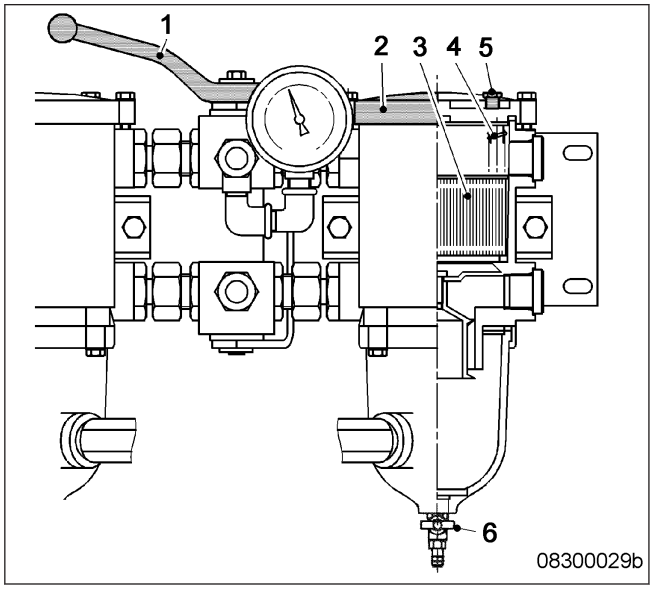


TIM-ID: 0000004937 - 015

2. Open threaded vent plug (5) of filter to be flushed.
3. Unlock drain valve (6) by pressing valve toggle, open it and drain fuel.

Result: Fuel flows from filtered side back to the unfiltered side, flushing the filter deposits downwards out of the filter.

4. Close threaded vent plug (5) and drain valve (6).



Fuel prefilter – Topping up with fuel

1. Stop engine (→ Page 46) and disable engine start.
2. Remove screws for cover and take off cover (2).
3. Fill filter housing with clean fuel.
4. Place new gasket in cover (2).
5. Fit cover with gasket and secure it with screws.
6. Check differential pressure (→ Page 128).

Result: If flushing did not lead to an improvement of the differential pressure, replace filter element of fuel prefilter (→ Page 132).

TIM-ID: 0000004937 - 015

6.8.6 Fuel prefilter – Filter element replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

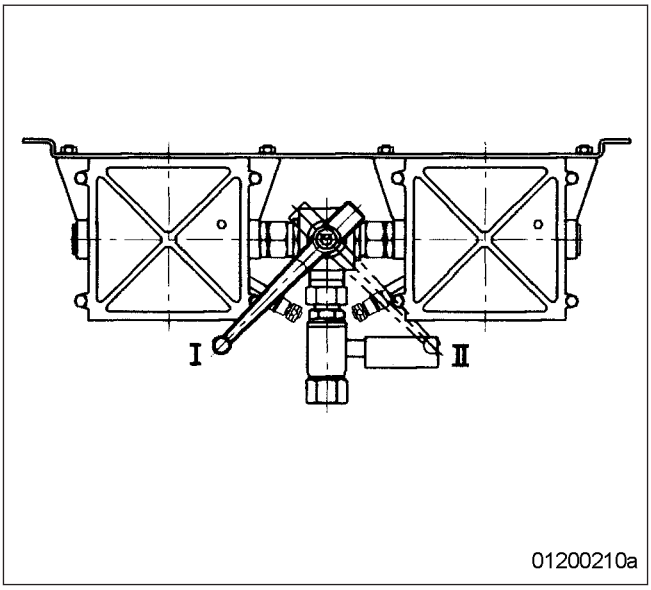
Designation / Use	Part No.	Qty.
Diesel fuel		
Filter element	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

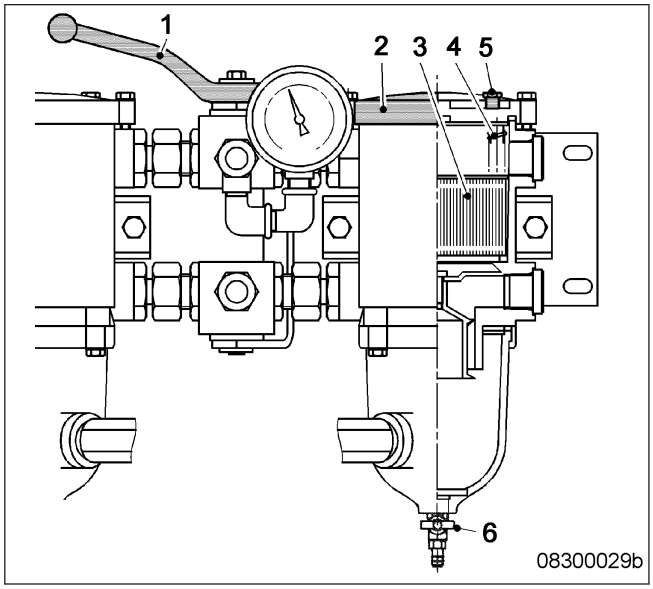
Replacing filter element

1. Cut out filter to be drained.
   - I Left filter cut in
   - II Right filter cut in



TIM-ID: 0000004944 - 004

2. Open threaded vent plug (5) of contaminated filter.
3. Unlock drain valve (6) by pressing toggle and open it.
4. Drain water and dirt from filter.
5. Close drain valve (6).
6. Remove screws securing the cover and take off cover (2).
7. Remove spring housing (4) and filter element (3).
8. Insert new filter element (3) and spring housing (4).
9. Fill filter housing with clean fuel.
10. Place new gasket in cover (2).
11. Fit cover with gasket and secure it with screws.
12. Cut in the cut-out filter again.
13. Close threaded vent plug (5) when fuel emerges.
14. Adjust the differential pressure gauge (→ Page 128).



TIM-ID: 0000004944 - 004

6.9 Charge-Air Cooling

6.9.1 Intercooler – Checking condensate drain for coolant discharge and obstructions

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

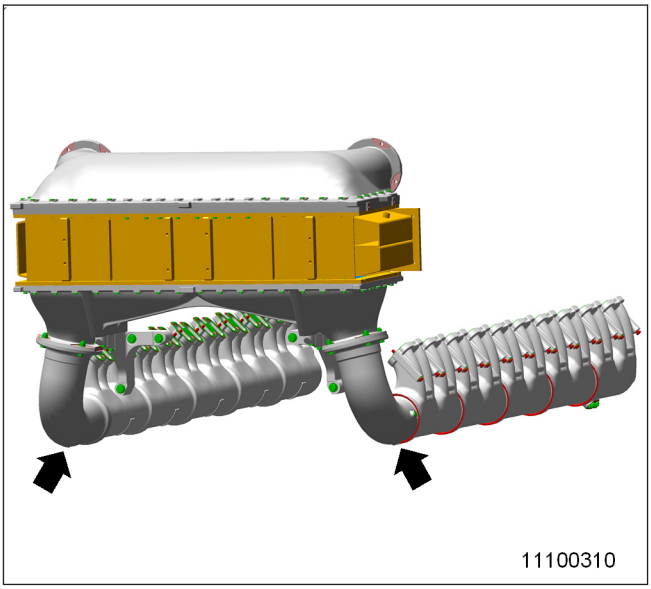
Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

Intercooler – Checking condensate drain for coolant discharge and obstructions

1. With the engine running, verify that air emerges from the condensate drain bore(s) at driving end, left and right engine side. If no air emerges:
   - Clean condensate drain bore(s)
   - Blow out with compressed air
2. If a large amount of coolant is continuously discharged, the intercooler is leaking. Contact Service.



Emergency measures prior to engine start with a leaking intercooler

1. Remove injectors (→ Page 120).
2. Bar engine manually (→ Page 104).
3. Bar engine with starting system to blow out combustion chambers (→ Page 105).
4. Install injectors (→ Page 120).

TIM-ID: 0000019861 - 001

6.10 Air Filter

6.10.1 Air filter – Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Air filter	(→ Spare Parts Catalog)	

Air filter – Replacement

1. Remove air filter and install new one (→ Page 137).
2. Reset signal ring of service indicator (→ Page 138).

TIM-ID: 0000000903 - 004

6.10.2 Air filter – Check

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Air filter	(→ Spare Parts Catalog)	

Air filter – Check

1. Check entire circumference of air filter for damage.
2. Fit new air filter if damaged (→ Page 137).

TIM-ID: 0000005430 - 003

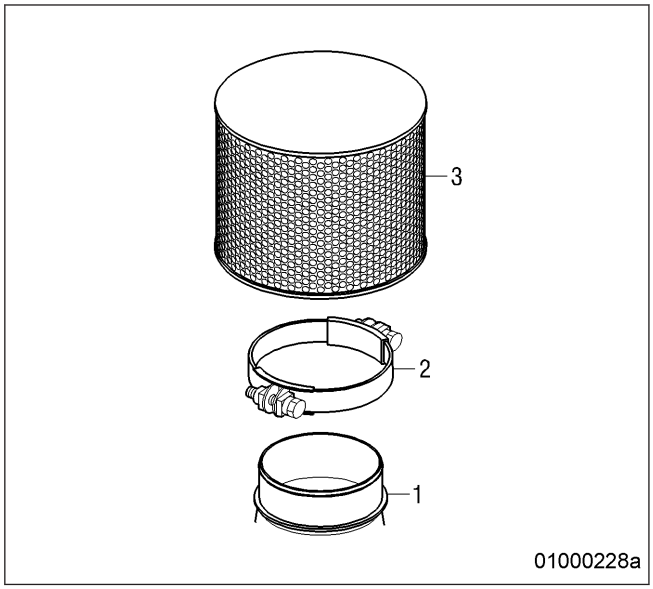
6.10.3 Air filter – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Removing and installing air filter

1. Release clamp (2).
2. Remove air filter (3) and clamp (2) from connecting flange of intake housing (1).
3. Verify that there are no objects in the connecting flange of the intake housing (1) and clean it.
4. Place new air filter (3) with clamp (2) onto intake housing (1).
5. Tighten clamp (2).



TIM-ID: 0000005457 - 006

6.11 Air Intake

6.11.1 Contamination indicator – Signal ring position check (optional)

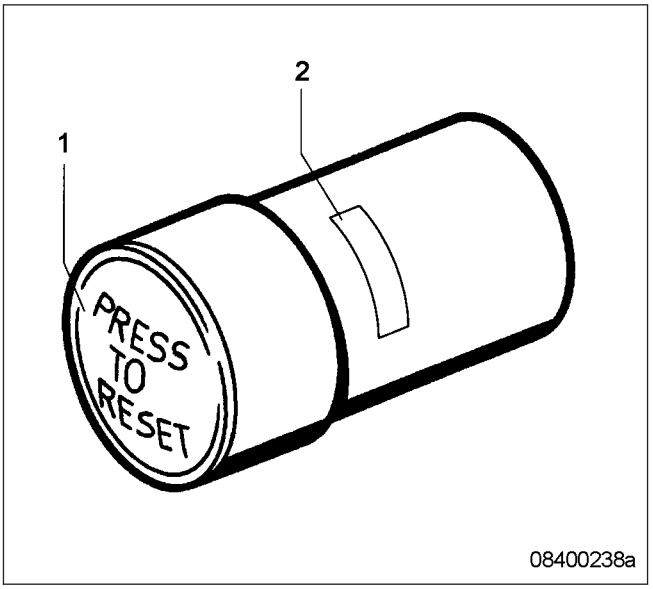
Preconditions

☑ Engine is stopped and starting disabled.

Checking signal ring position

1. If the signal ring is completely visible in the observation window (2), replace air filter (→ Page 135).
2. After installation of new filter, press reset button (1).

Result: Engaged piston with signal ring moves back to initial position.



TIM-ID: 0000005484 - 007

6.12 Starting Equipment

6.12.1 Air starter – Manual operation

DANGER

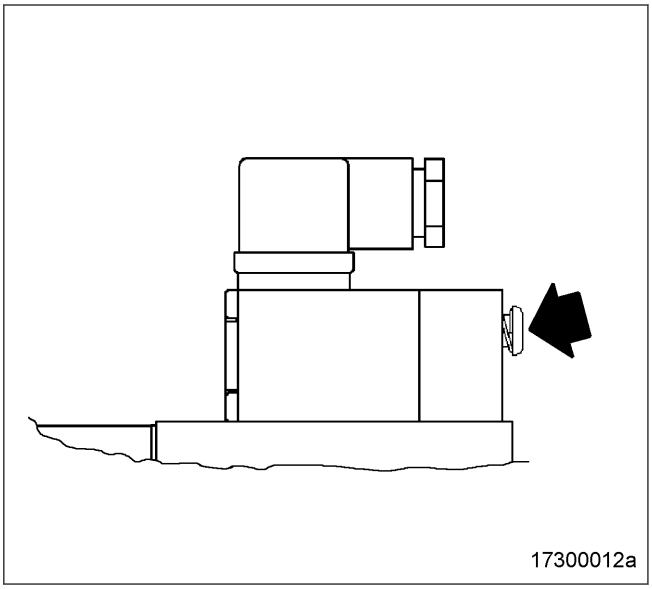
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Air starter – Manual operation

1. Press pushbutton for manual start and hold it.
2. Allow compressed air to enter the air starter, until the engine fires evenly.
3. Release pushbutton.



TIM-ID: 0000006076 - 003

6.13 Lube Oil System, Lube Oil Circuit

6.13.1 Engine oil – Change

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine is at operating temperature.

☑ MTU fluids and lubricants specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 40-200 Nm	F30027337	1
Ratchet adapter	F30027341	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Version without semirotary hand pump: Drain the engine oil through the drain plug(s) on the oil pan.

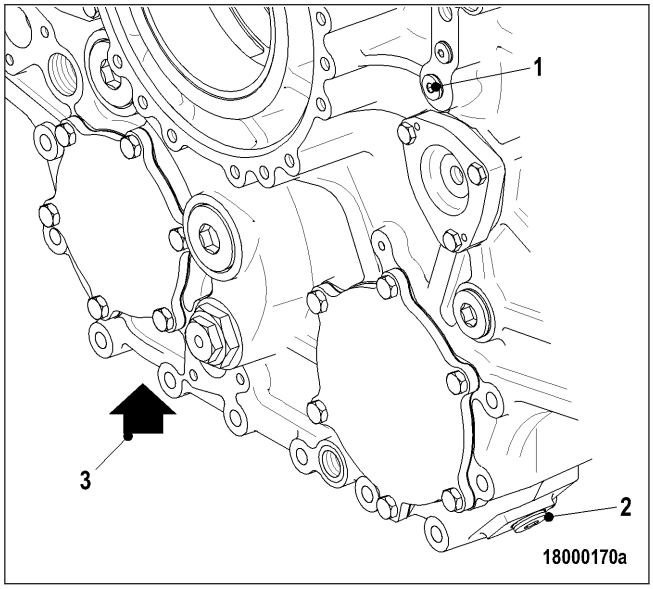
1. Provide a suitable container in which to collect the engine oil.
2. Remove drain plug(s) and drain engine oil.
3. Install drain plug(s) with new sealing ring.

Version with semirotary hand pump: Extracting the engine oil

1. Provide a suitable container in which to collect the engine oil.
2. Extract all engine oil from oil pan using the semirotary hand pump.

TIM-ID: 0000000930 - 007

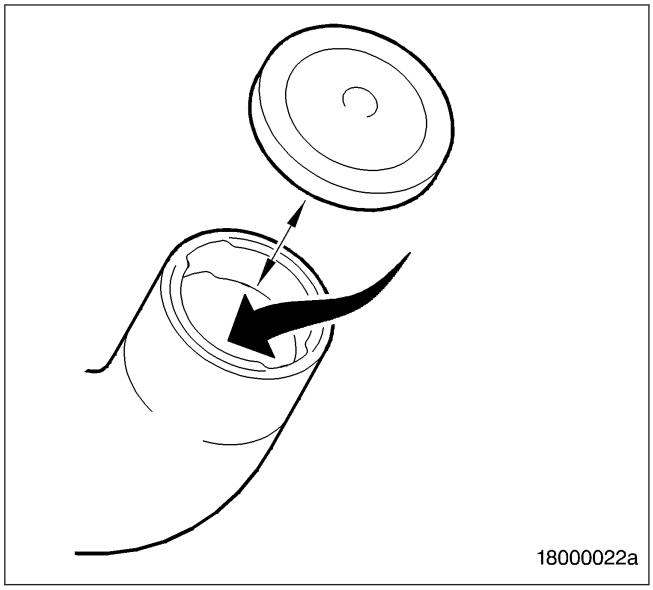
Draining residual oil from equipment carrier (only with unscheduled engine oil change)



1. Provide a suitable container in which to collect the engine oil.
2. Remove drain plug (1) and drain engine oil from engine oil heat exchanger and from engine oil filter.
3. Remove drain plugs (2) and (3) and drain engine oil.
4. Replace engine oil filter (→ Page 144).
5. Install drain plug(s) with new sealing ring.
6. Tighten drain plugs (2) and (3) with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M26 x 1.5	Tightening torque	(Engine oil)	100 Nm +10 Nm

Filling with new engine oil



1. Open cover on filler neck.
2. Pour engine oil through the filler neck up to the "max." mark on the oil dipstick.
3. Close cover on filler neck.
4. Check engine oil level (→ Page 142).

TIM-ID: 0000000930 - 007

6.13.2 Engine oil level – Check

Preconditions

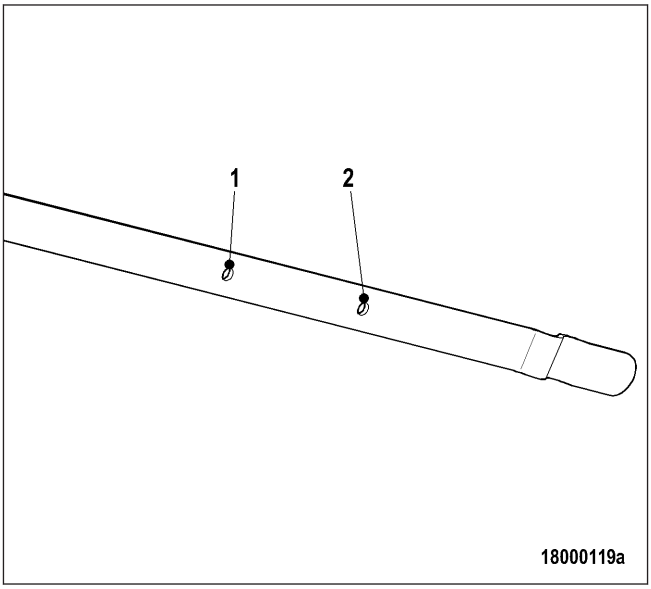
☑ Engine shut down and starting disabled.

Checking oil level prior to engine start

1. Withdraw oil dipstick from guide tube and wipe it.
2. Insert oil dipstick into guide tube up to stop, withdraw after approx. 10 seconds and check oil level.

Note: After extended standstill, the oil level may exceed the mark (1) by up to 2 cm. This can be caused by oil flowing from e.g. oil filter or heat exchanger back to the oil pan.

3. The oil level must reach mark (1) or exceed mark (1) by up to 2 cm.
4. Top up with oil to mark (1) as necessary (→ Page 140).
5. Insert oil dipstick into guide tube up to the stop.



Checking oil level after the engine is stopped

1. 5 minutes after stopping the engine, remove oil dipstick from the guide tube and wipe it.
2. Insert oil dipstick into guide tube up to stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between marks (1) and (2).
4. Top up with oil to mark (1) as necessary (→ Page 140).
5. Insert oil dipstick into guide tube up to the stop.

TIM-ID: 0000000931 - 009

6.13.3 Engine oil – Sample extraction and analysis

Preconditions

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

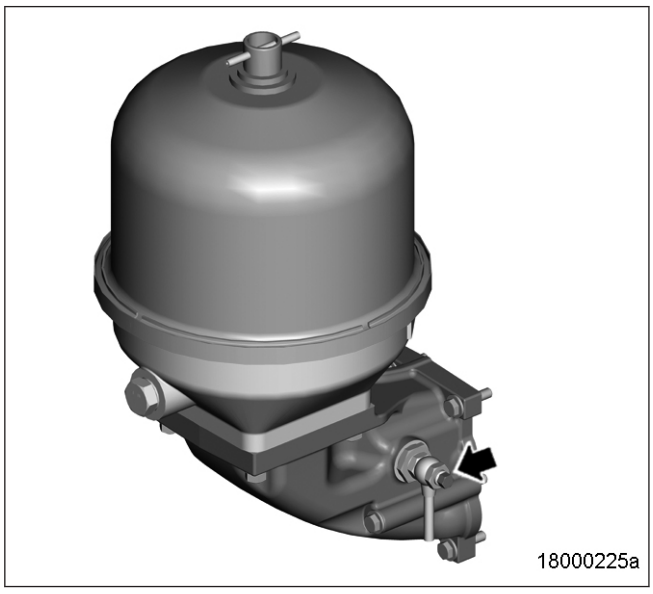
Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Engine oil – Sample extraction and analysis

1. With the engine running at operating temperature, open screw on centrifugal oil filter carrier by 1 to 2 rotations.
2. Drain approx. 2 liters engine oil to flush out the oil sludge.
3. Drain approx. 1 liter engine oil into a clean container.
4. Close screw.
5. Using the equipment and chemicals of the MTU test kit, examine oil for:
   - Dispersion capability (spot test);
   - Water content;
   - Dilution by fuel.



TIM-ID: 0000000932 - 003

6.14 Oil Filtration / Cooling

6.14.1 Engine oil filter – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

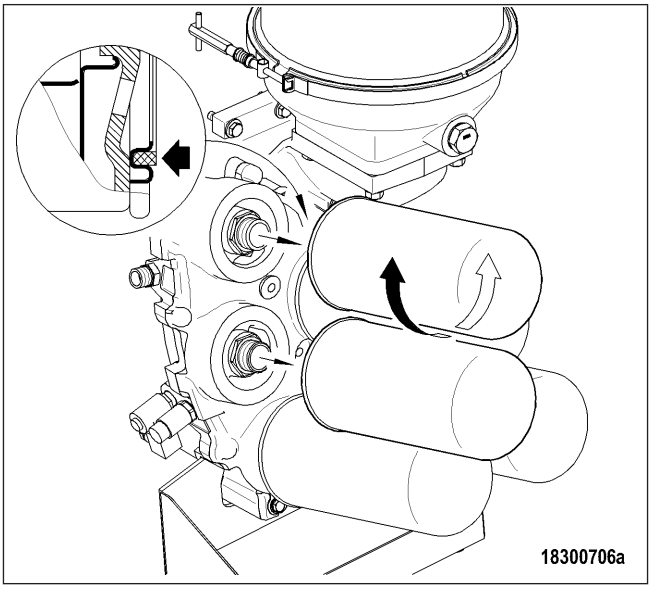
Designation / Use	Part No.	Qty.
Filter wrench	F30379104	
Engine oil		
Oil filter	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Engine oil filter – Replacement

1. Unscrew engine oil filter with filter wrench.
2. Clean sealing face on connecting piece.
3. Check sealing ring of new engine oil filter and apply a thin layer of engine oil.
4. Screw on and tighten engine oil filter by hand.
5. Replace other engine oil filters in the same way.
6. Check engine oil level (→ Page 142).
7. After changing engine oil and replacing oil filter(s), bar engine with starting equipment(→ Page 105).



TIM-ID: 0000000933 - 006

6.14.2 Centrifugal oil filter – Cleaning and filter sleeve replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Cold cleaner (Hakutex 60)	X00056750	1
Filter sleeve	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING

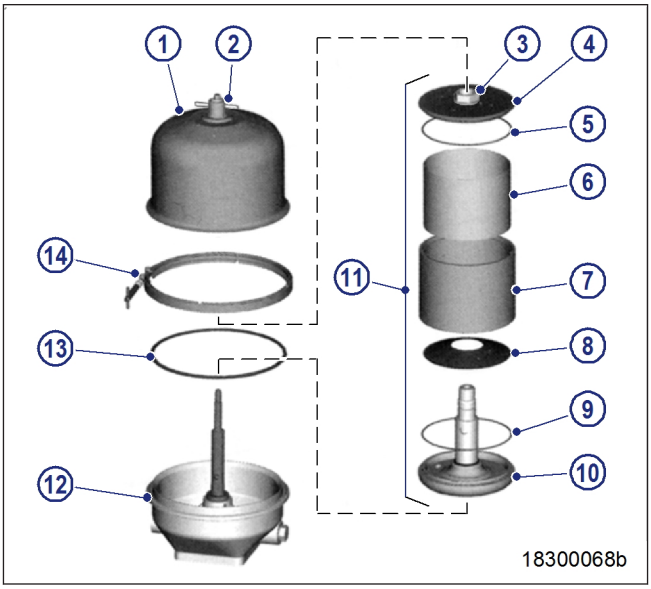
Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

TIM-ID: 0000000934 - 008

Centrifugal oil filter cleaning and filter sleeve replacement



1. Remove clamp (14).
2. Release cover screw (2) and take off cover (1).
3. Carefully lift rotor (11), allow oil to drain and remove from housing.
4. Holding the rotor (11) firmly, release rotor cover nut (3).
5. Take off rotor cover (4).
6. Remove filter sleeve (6).
7. Measure thickness of oil residues on filter sleeve (6).
8. If maximum layer thickness of oil residues exceeds 45 mm, shorten maintenance interval.
9. Disassemble rotor tube (7), conical disk (8) and rotor base (10).
10. Wash rotor cover (4), rotor tube (7), conical disk (8) and rotor base (10) with cold cleaner.
11. Blow out with compressed air.
12. Check sealing ring (9), fit new one if necessary.
13. Assemble rotor tube (7), conical disk (8) and rotor base (10) with sealing ring (9).
14. Insert new filter sleeve (6) in rotor tube (7) with the smooth paper surface facing the outer wall.
15. Check sealing ring (5), fit new one if necessary.
16. Mount rotor cover (4) with sealing ring (5).
17. Tighten rotor cover nut (3) with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque		35 Nm to 45 Nm

18. Place rotor (11) in housing (12) and check for ease of movement.
19. Check sealing ring (13), fit new one if necessary.
20. Fit sealing ring (13) on housing (12).
21. Fit cover (1).
22. Fit cover screw (2) by hand.
23. Install clamp (14) and tighten with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		8 Nm to 10 Nm

24. Tighten cover nut (2) with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		5 Nm to 7 Nm

TIM-ID: 0000000934 - 008

6.15 Coolant Circuit, General, High-Temperature Circuit

6.15.1 Engine coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

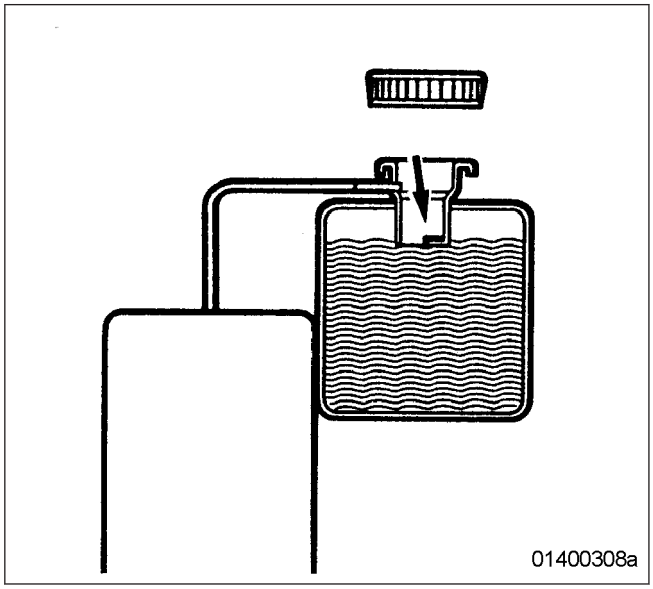
☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Coolant-level check at remote cooler:

1. Check coolant level (coolant must be visible at marking plate).
2. Top up with treated coolant as necessary (→ Page 150).
3. Check and clean breather valve.
4. Set breather valve onto filler neck and close it.



Checking engine coolant level by means of level sensor:

1. Switch on engine control system and check readings on the display.
2. Top up with treated coolant as necessary (→ Page 150).

TIM-ID: 0000018677 - 001

6.15.2 Engine coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Engine coolant – Change

1. Drain engine coolant (→ Page 149).
2. Fill with engine coolant (→ Page 150).

TIM-ID: 0000000036 - 030

6.15.3 Engine coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

WARNING

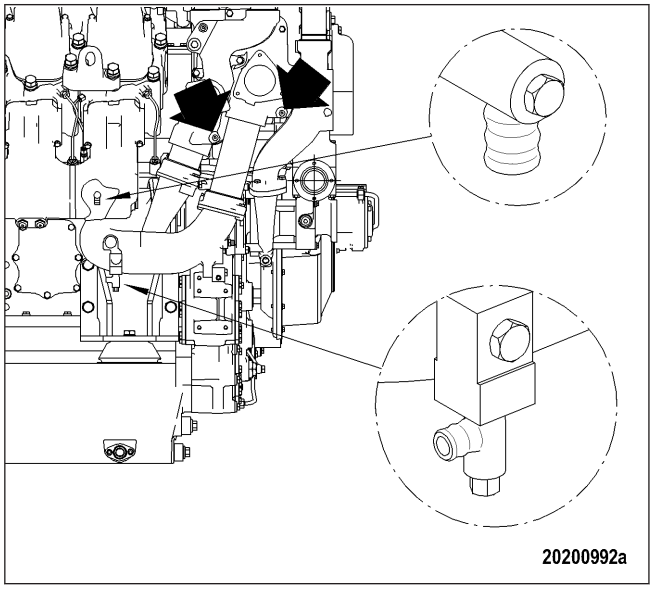
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Preparatory steps

1. Provide an appropriate container to drain the coolant into.
2. Switch off preheating unit.

Engine coolant – Draining

1. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Draw off separated corrosion inhibitor oil in expansion tank through the filler neck.
4. Open drain valves and/or drain plugs and drain coolant at the following points:
   - Preheating unit
   - Thermostat housing (arrow)
   - Twin elbow (arrow)
   - HT coolant pump elbow;
   - Crankcase, left and right sides.
5. Close all open drain points.
6. Place breather valve on filler neck and close.



TIM-ID: 0000000960 - 002

6.15.4 Engine coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine coolant		

WARNING

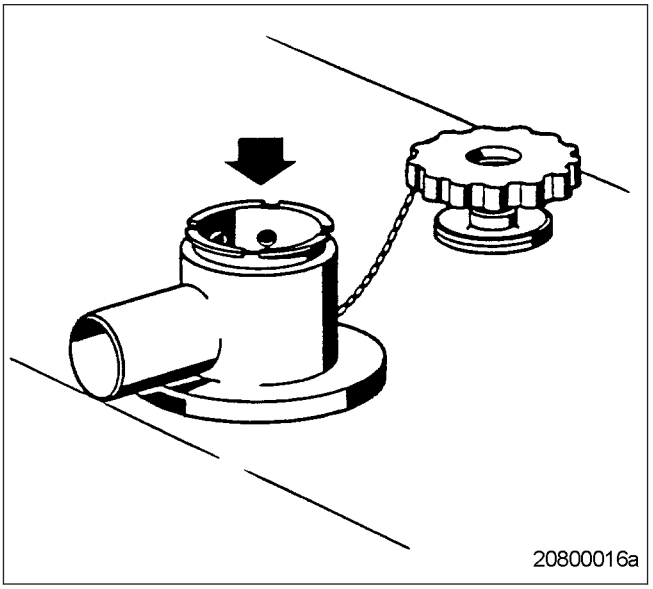
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

Cold coolant in hot engine can cause thermal stress.
Formation of cracks in components!
- Fill / top up coolant only into cold engine.

Preparatory steps

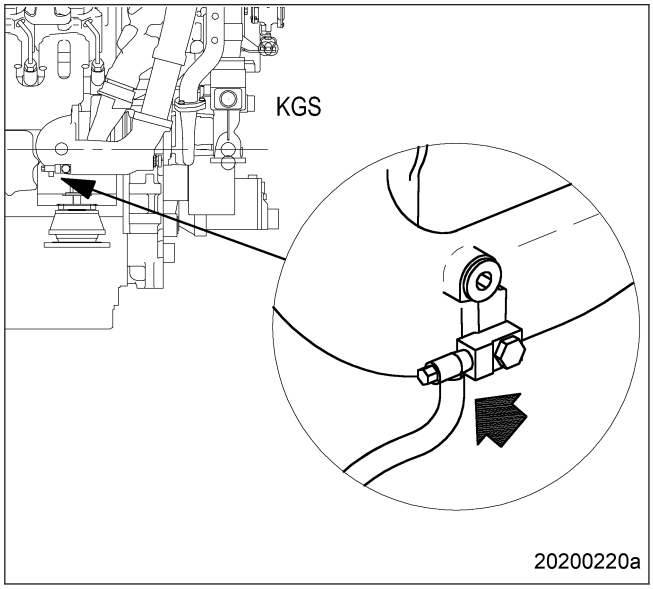
1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.



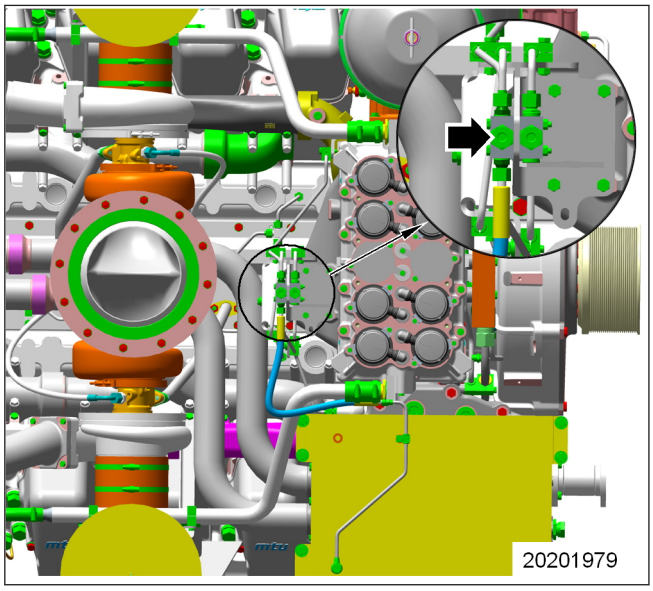
TIM-ID: 0000019863 - 001

Filling coolant with pump

1. Connect appropriate pump with hose to the drain valve of the engine coolant pump (arrow).

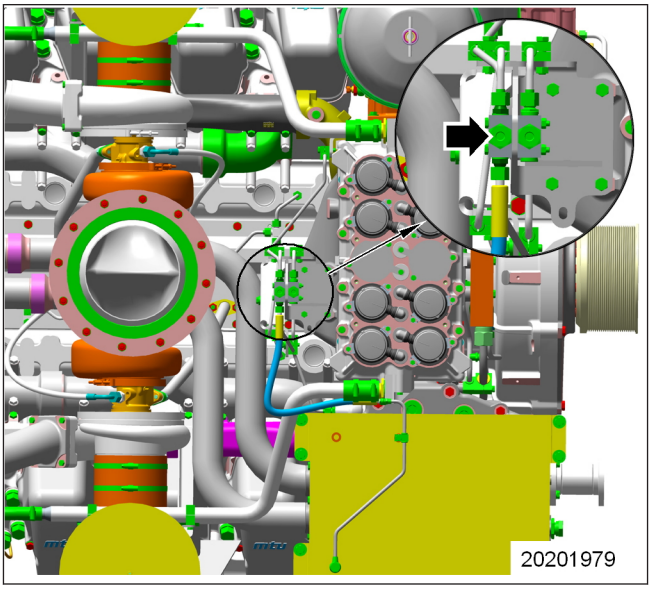


2. Open venting point at distributor (arrow).
3. Open drain valve and pump coolant into engine at 0.5 bar minimum.
4. Close venting point when coolant emerges.
5. Fill expansion tank until overflow edge is reached.
6. Close drain valve.
7. Check proper condition of breather valve on coolant expansion tank, clean sealing faces if required.
8. Fit breather valve and close it.
9. Start engine (→ Page 42).
10. After 10 seconds of running the engine without load, shut down the engine (→ Page 46).
11. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
12. Continue to turn breather valve counterclockwise and remove.
13. Check coolant level (→ Page 147) and top up coolant as required:
    a) Fill in coolant in expansion tank until the coolant level at top edge of filler neck remains constant.
    b) Fit breather valve and close it.
14. Repeat the steps from "Start engine" (→ Step 9) until coolant no longer needs to be topped up.
15. Disconnect pump and hose.



TIM-ID: 0000019863 - 001

Alternatively: Filling coolant through filler neck



1. Open venting point at distributor (arrow).
2. Fill in coolant in expansion tank via filler neck until coolant level at top edge of filler neck remains constant.
3. Close venting point when coolant emerges.
4. Check proper condition of breather valve on coolant expansion tank, clean sealing faces if required.
5. Fit breather valve and close it.
6. Start engine (→ Page 42).
7. After 10 seconds of running the engine without load, shut down the engine (→ Page 46).
8. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
9. Turn breather valve counterclockwise and remove.
10. Check coolant level (→ Page 147) and top up with coolant through the filler neck if required:
    a) Fill in coolant in expansion tank until the coolant level at top edge of filler neck remains constant.
    b) Fit breather valve and close it.
11. Repeat the steps from "Start engine" (→ Step 6) until coolant no longer needs to be topped up.

Final steps

1. Start the engine and run it without load for some minutes.
2. Check coolant level (→ Page 147) and top up coolant as required.

TIM-ID: 0000019863 - 001

6.15.5 Engine coolant pump – Relief bore check

DANGER

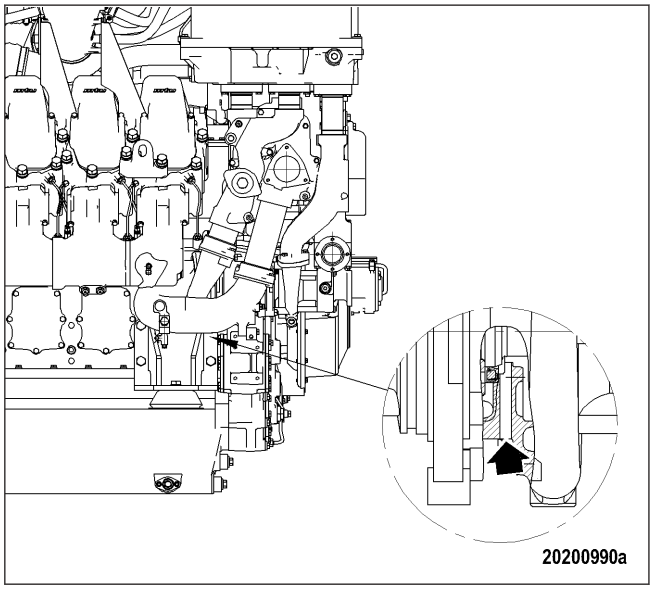
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Engine coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
2. Shut down engine (→ Page 46) and disable engine start, observe general safety instructions “Maintenance and Repair”.
3. Clean the relief bore with a wire if it is dirty.
   - Permissible coolant discharge: up to 10 drops per hour;
   - Permissible oil discharge: up to 5 drops per hour.
4. If discharge exceeds the specified limits: Contact Service.



TIM-ID: 0000000939 - 002

6.15.6 Engine coolant – Sample extraction and analysis

Preconditions

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

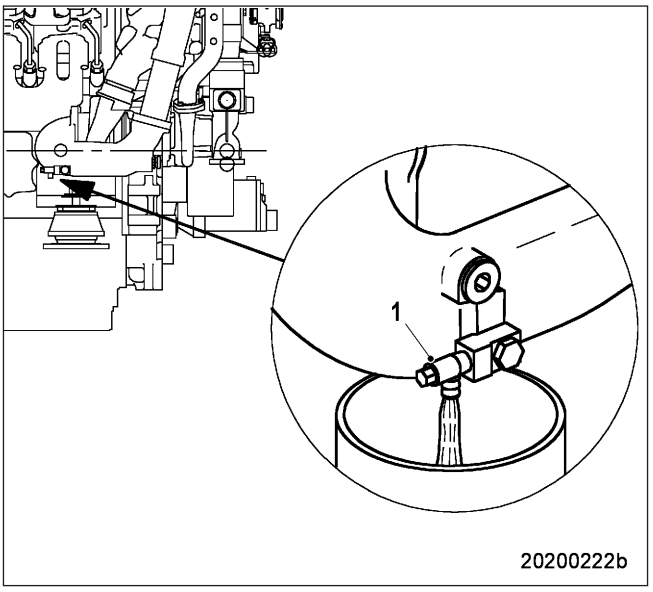
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Engine coolant – Sample extraction and analysis

1. With the engine running, open drain valve (1).
2. Flush sample-extraction point by draining approx. 1 liter coolant.
3. Drain approx. 1 liter coolant into a clean container.
4. Close drain valve (1).
5. Using the equipment and chemicals of the MTU test kit, check the coolant for:
   - Antifreeze concentration
   - Corrosion inhibitor concentration
   - pH value.
6. For engine coolant change intervals, refer to (→ MTU Fluids and Lubricants Specifications).



TIM-ID: 0000000938 - 006

6.16 Low-Temperature Circuit

6.16.1 Charge-air coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

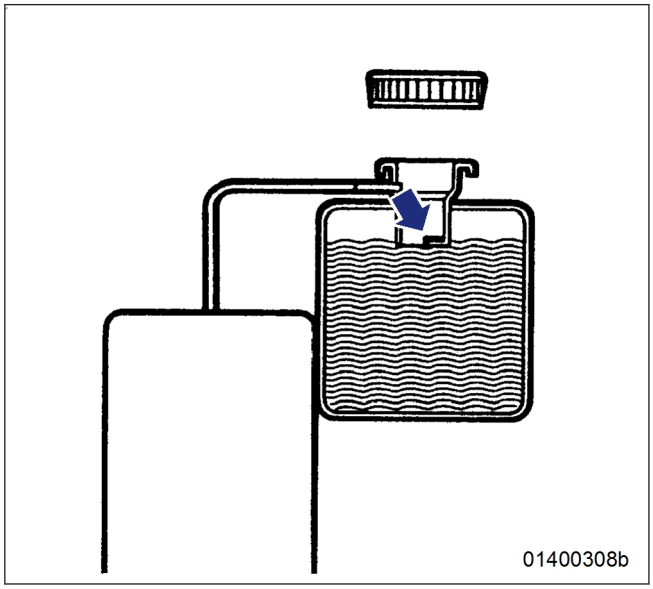
☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Checking charge-air coolant level at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Check coolant level (coolant must be visible at marking plate).
4. Top up coolant if necessary (→ Page 158).
5. Check proper condition of breather valve, clean sealing faces if required.
6. Fit breather valve and close it.



Checking charge-air coolant level by means of level sensor:

1. Switch on engine control system and check display (coolant level is automatically monitored by engine control system).
2. Top up coolant if necessary (→ Page 158).

TIM-ID: 0000000042 - 007

6.16.2 Charge-air coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Charge-air coolant – Change

1. Drain charge-air coolant (→ Page 157).
2. Fill with charge-air coolant (→ Page 158).

TIM-ID: 0000000041 - 011

6.16.3 Charge-air coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

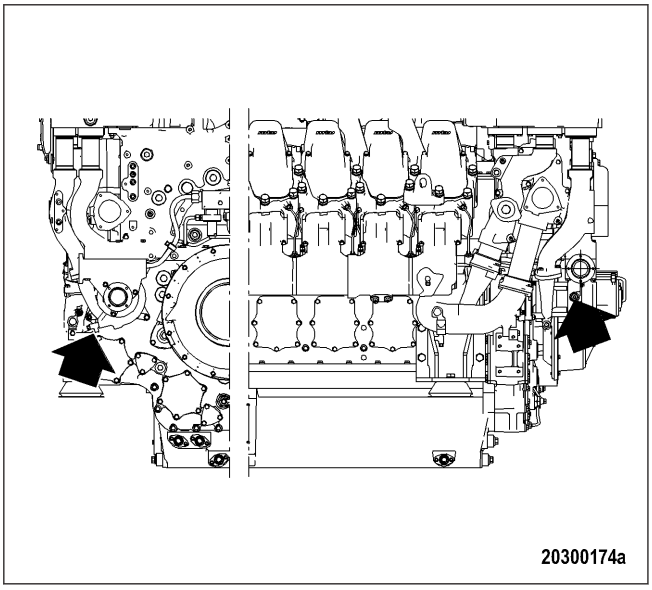
Designation / Use	Part No.	Qty.
Sealing ring	(→ Spare Parts Catalog)	

WARNING

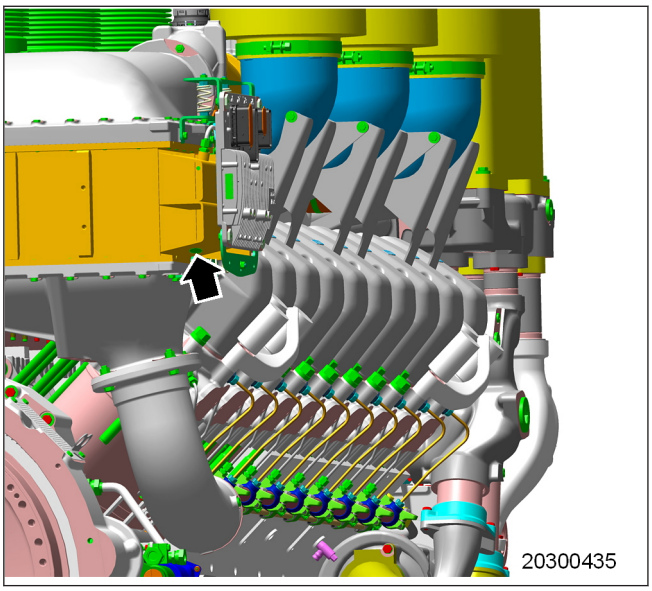
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Draining charge-air coolant

1. Provide a suitable receptacle to catch the coolant.
2. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
3. Continue to turn breather valve counter-clockwise and remove.
4. Draw off separated corrosion inhibitor oil in expansion tank through the filler neck.
5. Open drain valves and/or drain plugs and drain coolant at the following points:
   - at the LT coolant pump
   - at the LT thermostat housing.



6. Draining of residual coolant:
   - at the intercooler
7. Close all drain valves and screw in drain plugs with new sealing rings.
8. Set breather valve onto filler neck and close it.



TIM-ID: 0000019865 - 001

6.16.4 Charge-air coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Charge-air coolant		

WARNING

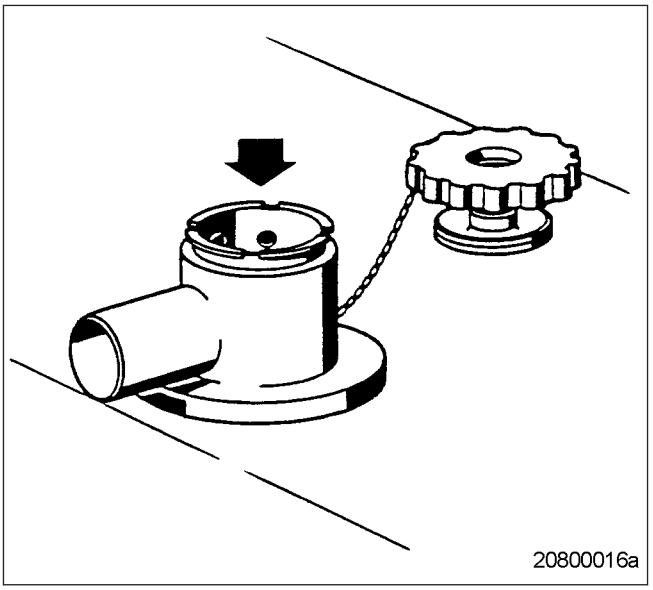
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

Cold coolant in hot engine can cause thermal stress.
Formation of cracks in components!
- Fill / top up coolant only into cold engine.

Preparatory steps

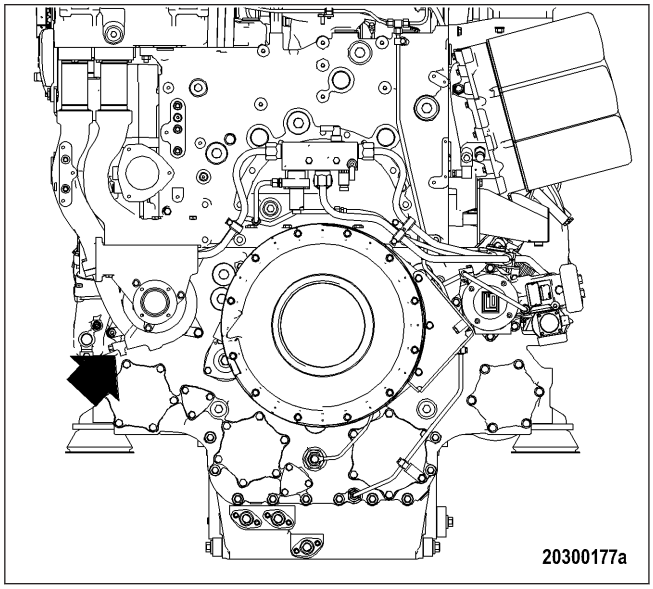
1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.



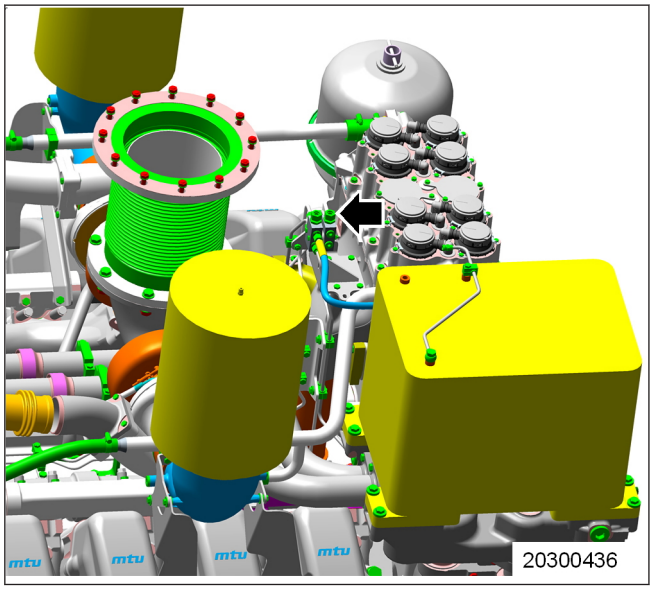
TIM-ID: 0000019867 - 001

Filling coolant with pump

1. Connect a suitable pump with a hose to the drain valve (arrowed).

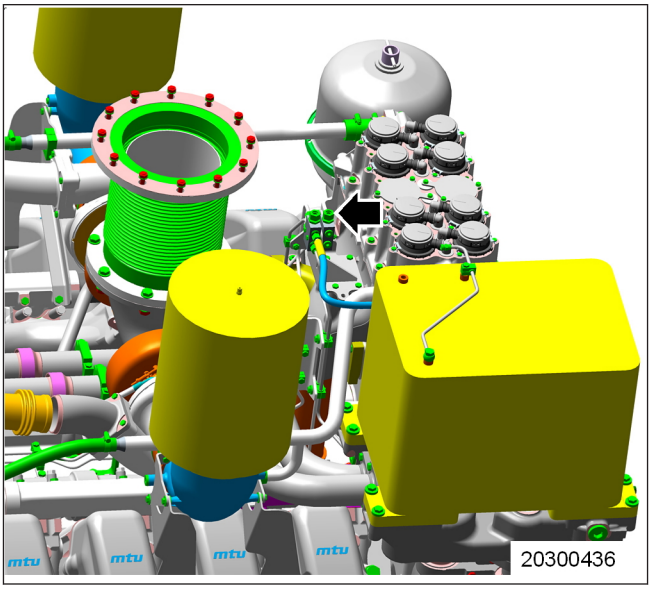


2. Undo the vent line union at the distributor piece (arrowed).
3. Open drain valve and pump coolant into engine at 0.5 bar minimum.
4. Tighten the union (arrowed) if coolant leaks out at the loose union.
5. Fill expansion tank until overflow edge is reached.
6. Close drain valve.
7. Check proper condition of breather valve and clean sealing faces if required.
8. Set breather valve onto filler neck and close it.
9. Start engine (→ Page 42).
10. After 10 seconds of running the engine without load, shut down the engine (→ Page 46).
11. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
12. Continue to turn breather valve counterclockwise and remove.
13. Check coolant level (→ Page 155) and top up coolant as required:
    a) Fill in coolant in expansion tank until the coolant level at top edge of filler neck remains constant.
    b) Set breather valve onto filler neck and close it.
14. Repeat the steps from "Start engine" (→ Step 9) until coolant no longer needs to be topped up.
15. Disconnect pump and hose.



TIM-ID: 0000019867 - 001

Alternatively: Filling coolant through filler neck



1. Undo the vent line union at the distributor piece (arrowed).
2. Fill in coolant in expansion tank via filler neck until coolant level at top edge of filler neck remains constant.
3. Tighten the union (arrowed) if coolant leaks out at the loose union.
4. Check proper condition of breather valve on coolant expansion tank, clean sealing faces if required.
5. Fit breather valve and close it.
6. Start engine (→ Page 42).
7. After 10 seconds of running the engine without load, shut down the engine (→ Page 46).
8. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
9. Turn breather valve counterclockwise and remove.
10. Check coolant level (→ Page 155) and top up with coolant through the filler neck if required:
    a) Fill in coolant in expansion tank until the coolant level at top edge of filler neck remains constant.
    b) Fit breather valve and close it.
11. Repeat the steps from "Start engine" (→ Step 6) until coolant no longer needs to be topped up.

Final steps

1. Start the engine and run it without load for some minutes.
2. Check coolant level (→ Page 155) and top up coolant as required.

TIM-ID: 0000019867 - 001

6.16.5 Charge-air coolant pump – Relief bore check

DANGER

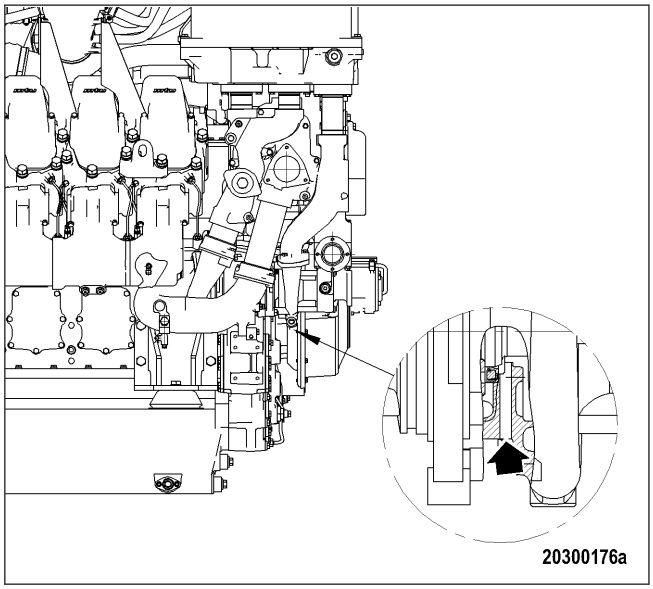
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

Charge-air coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
2. Shut down engine (→ Page 46) and disable engine start, observe general safety instructions “Maintenance and Repair”.
3. Clean the relief bore with a wire if it is dirty.
   - Permissible coolant discharge: up to 10 drops per hour;
   - Permissible oil discharge: up to 5 drops per hour.
4. If discharge exceeds the specified limits: Contact Service.



TIM-ID: 0000000943 - 002

6.17 Belt Drive

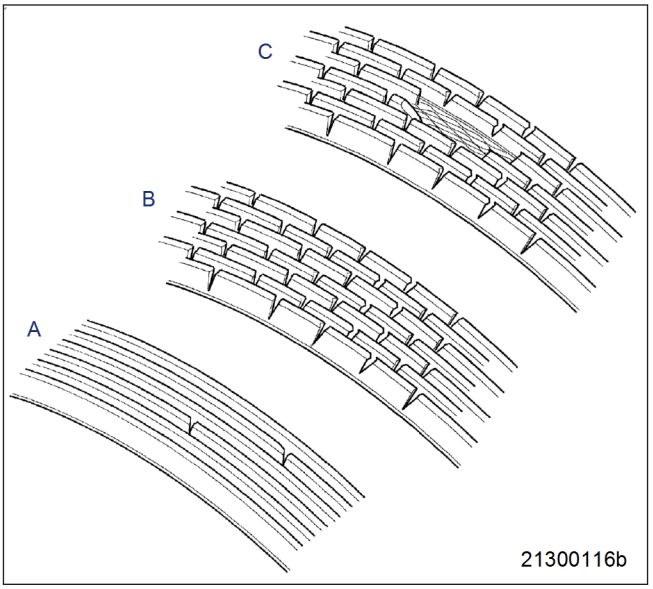
6.17.1 Drive belt – Condition check

Preconditions

☑ Engine is stopped and starting disabled.

☑ Guard is removed.

Drive belt – Condition check



Item	Findings	Action
Drive belt A	Singular cracks	None
Drive belt	Belt is oily, shows signs of over-heating	Replace (→ Page 164)
Drive belt B	Cracks on entire circumference	
Drive belt C	Chunking	

TIM-ID: 0000000920 - 010

6.18 Battery-Charging Generator

6.18.1 Battery-charging generator drive – Drive belt tension adjustment

Preconditions

☑ Engine is stopped and starting disabled.

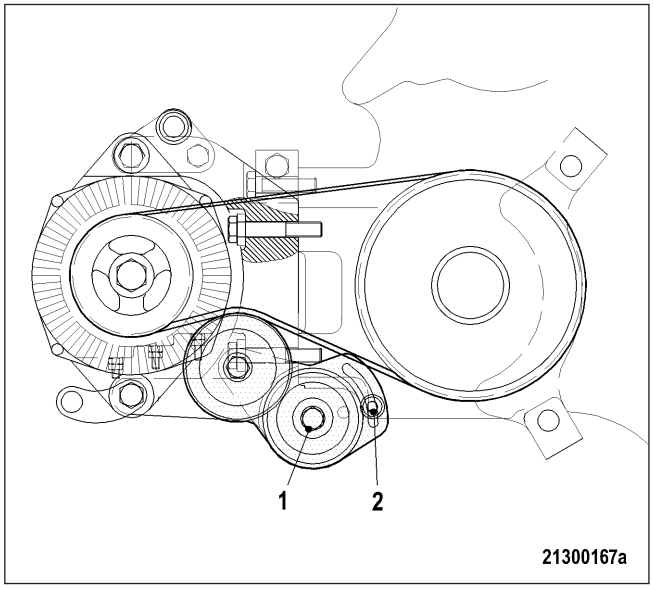
WARNING

Spring/circlip/tensioning roller preload.
Risk of injury!
- Only use specified tool and equipment.

Adjusting belt tension

1. Remove protective cover.
2. Slacken screws (1) and (2) by half a turn.

Result: Belt tensioner moves against the drive belt and tensions it.



3. Tighten screw (2) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M10x1.5	Tightening torque		60 Nm +5 Nm

4. Tighten screw (1) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M10x1.5	Tightening torque		42 Nm

5. Install protective cover.

TIM-ID: 0000000945 - 006

6.18.2 Battery-charging generator drive – Drive belt replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Drive belt	(→ Spare Parts Catalog)	

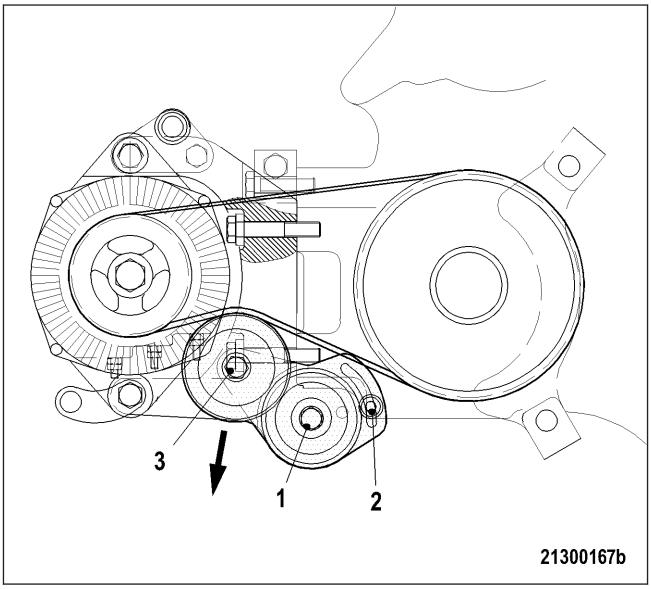
WARNING

Spring/circlip/tensioning roller preload.
Risk of injury!
- Only use specified tool and equipment.

Battery-charging generator drive – Drive belt replacement

1. Remove protective cover.
2. Slacken screws (1) and (2) by half a turn.
3. Place socket adapter or box wrench on screw (3) and press belt tensioner in the direction indicated by the arrow as far as it will go.
4. Tighten screw (2).
5. Remove the used drive belt.
6. Fit new drive belt.
7. Slacken screw (2) by half a turn.

Result: Belt tensioner moves against the drive belt and tensions it.



8. Tighten screw (2) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M10x1.5	Tightening torque		60 Nm +5 Nm

9. Tighten screw (1) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M10x1.5	Tightening torque		42 Nm

10. Install protective cover.
11. Readjust belt tension after 30 minutes and again after 8 hours engine runtime (→ Page 163).

TIM-ID: 0000022970 - 004

6.19 Wiring (General) for Engine/Gearbox/Unit

6.19.1 Engine wiring – Check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Engine wiring – Check

1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
2. Ensure that cables are fixed in their clamps and cannot swing freely.
3. Check that cable ties are firm, tighten loose cable ties.
4. Replace faulty cable ties.
5. Visually inspect the following electrical line components for damage:
   - connector housings;
   - contacts;
   - sockets;
   - cables and terminals;
   - plug-in contacts.
6. (→ Contact Service) if cable conductors are damaged.

Note: Close male connectors that are not plugged in with the protective cap supplied.

7. Clean dirty connector housings, sockets and contacts with isopropyl alcohol.
8. Ensure that all sensor connectors are securely engaged.

TIM-ID: 0000000029 - 018

6.20 Engine Mounting / Support

6.20.1 Engine mounting – Check

Engine mounting – Check

Item	Findings	Action
Visually inspect mounts.	• Damage • Brittleness • Deformation • Crack formation • Swelling visible	Replace (→ Instructions for General Overhaul)

TIM-ID: 0000015370 - 003

6.21 Accessories for (Electronic) Engine Governor / Control System

6.21.1 CDC parameters – Reset with DiaSys®

Preconditions

☑ Engine is stopped and starting disabled.

Resetting CDC parameters (DiaSys® is available)

Note: The CDC parameters must be reset, otherwise the emission certification of the engine is no longer applicable.

▶ Reset the CDC parameters with DiaSys® (→ Manufacturer's documentation).

Resetting CDC parameters (DiaSys® is not available)

Note: The CDC parameters must be reset, otherwise the emission certification of the engine is no longer applicable.

▶ Contact Service.

TIM-ID: 0000037821 - 001

6.21.2 Engine governor and connectors – Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose.Otherwise the contacts could be bent.

Engine governor and connectors – Cleaning

1. Remove coarse dirt from housing surface with isopropyl alcohol.
2. Remove dirt from connector and cable surfaces with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.

Cleaning severely contaminated connectors on the engine governor

Note: Seal unused connectors with the supplied protective cap.

1. Release the latch and pull off connectors.
2. Clean connector housings, connector socket housings and all contacts with isopropyl alcohol.
3. When connectors, sockets and all contacts are dry: Fit connectors and lock them.

TIM-ID: 0000000047 - 009

6.21.3 Engine governor – Checking plug-in connections

Preconditions

☑ Engine is stopped and starting disabled.

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose.Otherwise the contacts could be bent.

Checking plug-in connections on engine governor

1. Check all plug-in connections for secure seating.
2. Latch connectors if loose.

TIM-ID: 0000000048 - 005

6.21.4 ECU 7 engine governor – Removal and installation

Preconditions

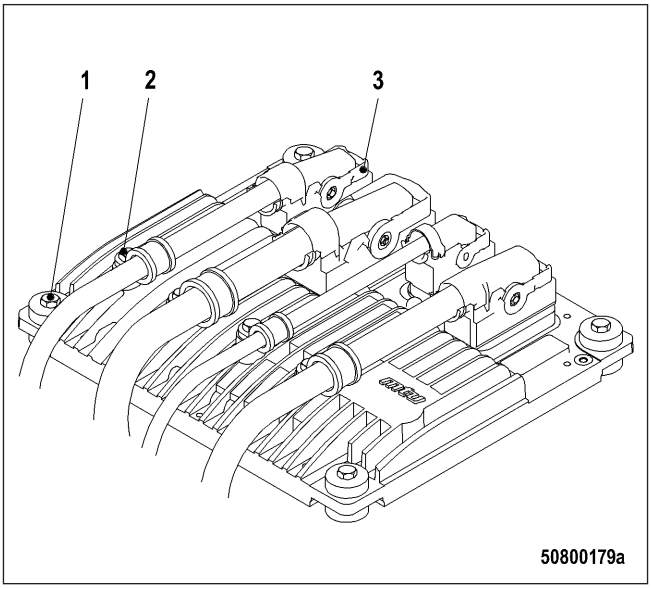
☑ Engine is stopped and starting disabled.

CAUTION

Wrong engine governor installed.
Engine damage!
- When reassembling an engine, make sure that the governor with the data record for the given engine is installed.

Removing engine governor from engine

1. Note or mark assignment of cables and connectors.
2. Remove all screws (2).
3. Undo latches (3) of the connectors.
4. Remove all connectors.
5. Remove screws (1).
6. Take off engine governor.



Installing engine governor on engine

1. Install in reverse order. In doing so, ensure correct assignment of connectors and sockets.
2. Check rubber mount before installation.

Result: If the rubber mount is porous or defective, replace it.

TIM-ID: 0000000049 - 005

7 Appendix A

7.1 Abbreviations

Abbreviation	Meaning	Explanation
A/D	Analog/Digital	Transformer: transforms sensor voltages into numeric values
ADEC	Advanced Diesel Engine Controller	Engine management system
AFRS	Air Filter Restriction Sensor	
ANSI	American National Standards Institute	Association of American standardization organizations
ATL	Abgasturbolader	Exhaust turbocharger (ETC)
ATS	Air Temperature Sensor	
BR	Baureihe	Series
BV	Betriebsstoffvorschrift	MTU Fluids and Lubricants Specifications, Publication No. A01061/..
CAN	Controller Area Network	Data bus system, bus standard
CDC	Calibration Drift Compensation	Setting of drift compensation in engine governor with DiaSys
CEL	Stop Engine Light	1st function: Warning lamp (rectify fault as soon as possible) 2nd function: Read out fault codes
CKT	Circuit	
CLS	Coolant Level Sensor	Monitors coolant level
CPS	Coolant Pressure Sensor	Monitors coolant pressure
CTS	Coolant Temperature Sensor	Monitors coolant temperature
DDEC	Detroit Diesel Electronic Controls	Engine control system made by Detroit Diesel
DDL	Diagnostic Data Link	Diagnostic lines
DDR	Diagnostic Data Reader	Diagnostic unit
DIN	Deutsches Institut für Normung e. V.	At the same time identifier of German standards (DIN = “Deutsche Industrie-Norm”)
DL	Default Lost	Alarm: Default CAN bus failure
DOC	Diesel Oxidation Catalyst	Oxidation catalyst upstream of the diesel particulate filter
DPF	Diesel Particulate Filter	
DT	Diagnostic Tool	Diagnostic unit
ECM	Electronic Control Module	Electronic control unit of the DDEC system
ECU	Engine Control Unit	Engine governor
EDM	Engine Data Module	Memory module for engine data
EEPROM	Electrically Erasable Programmable Read Only Memory	
EFPA	Electronic Foot Pedal Assembly	

TIM-ID: 0000000858 - 009

Abbreviation	Meaning	Explanation
EGR	Exhaust Gas Recirculation	
EMU	Engine Monitoring Unit	
ETK	Ersatzteilkatalog	Spare Parts Catalog (SPC)
EUI	Electronic Unit Injector	
FPS	Fuel Pressure Sensor	Monitors fuel pressure
FRS	Fuel - Differential Pressure Sensor	
FTS	Fuel Temperature Sensor	Monitors fuel temperature
FWCP	Fire Water Control Panel	Control cabinet
GND	Ground	
HD	Hochdruck	High Pressure (HP)
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit value
HT	High Temperature	
IDM	Interface Data Module	Memory module for interface data
INJ	Injector	
ISO	International Organization for Standardization	International umbrella organization for all national standardization institutes
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204
LED	Light Emitting Diode	
LO	Low	Alarm: Measured value lower than 1st minimum limit value
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit value
LSG	Limiting Speed Governor	
N/A	Not Applicable	
LP	Low Pressure	
OEM	Original Equipment Manufacturer	
OI	Optimized Idle	
OLS	Oil Level Sensor	Monitors oil level
OPS	Oil Pressure Sensor	Monitors oil pressure
OTS	Oil Temperature Sensor	Monitors oil temperature
OT	Oberer Totpunkt	Top Dead Center (TDC)
PAN	Panel	Control panel
PIM	Peripheral Interface Module	
PWM	Modulated signal	
P-xyz	Pressure-xyz	Pressure measuring point, xyz specifies the measuring point designation
RL	Redundancy Lost	Alarm: Redundant CAN bus failure

TIM-ID: 0000000858 - 009

Abbreviation	Meaning	Explanation
SAE	Society of Automotive Engineers	U.S. standardization organization
SD	Sensor Defect	Alarm: Sensor failure
SEL	Stop Engine Light	1st function: Warning lamp (stop engine and rectify fault) 2nd function: Read out fault codes
SID	System Identifier	
SRS	Synchronous Reference Sensor	TDC cylinder 1
SS	Safety System	Safety system alarm
TBS	Turbocharger Boost Sensor	Monitors charge-air pressure
TCI	Turbo Compressor Inlet	
TCO	Turbo Compressor Outlet	
TD	Transmitter Deviation	Alarm: Deviation in transmitter values
TPS	Throttle Position Sensor	
TRS	Timing Reference Sensor	
T-xyz	Temperature-xyz	Temperature measuring point, xyz specifies the measuring point designation
UT	Unterer Totpunkt	Bottom Dead Center (BDC)
VNT	Variable Nozzle Turbine	
VSG	Variable-Speed Governor	
VSS	Vehicle Speed Sensor	
WZK	Werkzeugkatalog	Tool Catalog (TC)

TIM-ID: 0000000858 - 009

7.2 MTU contacts/service partners

Service

Our worldwide sales network with its subsidiaries, sales offices, representatives and customer service centers ensures fast and direct support on site and the high availability of our products.

Local support

Experienced and qualified specialists place their knowledge and expertise at your disposal.

For locally available support, go to the MTU Internet site: http://www.mtu-online.com

24h hotline

With our 24h hotline and the outstanding flexibility of our service staff, we are always ready to assist you - either during operation, for preventive maintenance, corrective work in case of malfunction or changed operating conditions, or for spare parts supply.

Your contact at Headquarters: Service-support@mtu-online.com

Spare parts service

Fast, simple and correct identification of spare parts for your drive system or vehicle fleet. The right spare part at the right time at the right place.

With this aim in mind, we can call on a globally networked spares logistics system, a central warehouse at headquarters and on-site stores at our subsidiary companies, agencies and service workshops.

Your contact at Headquarters:

E-mail: spare.parts@mtu-online.com

Tel.: +49 7541 908555

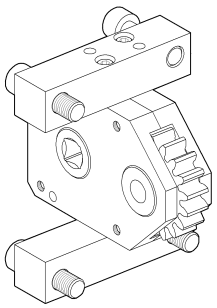
Fax.: +49 7541 908121

TIM-ID: 0000000873 - 013

8 Appendix B

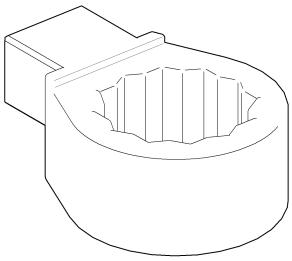
8.1 Special Tools

Barring device



Part No.:	F6555766
Qty.: Used in:	1 6.1.1 Engine – Barring manually (→ Page 104)

Box wrench socket, 24 mm

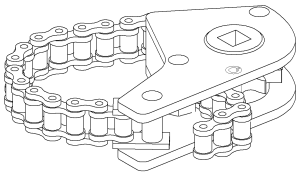


Part No.:	F30039526
Qty.: Used in:	1 6.4.2 Valve clearance – Check and adjustment (→ Page 113)

Feeler gauge

Part No.:	Y20098771
Qty.: Used in:	1 6.4.2 Valve clearance – Check and adjustment (→ Page 113)

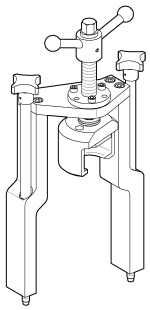
Filter wrench



Part No.:	F30379104
Qty.: Used in:	1 6.8.1 Fuel filter – Replacement (→ Page 126)
Qty.: Used in:	6.14.1 Engine oil filter – Replacement (→ Page 144)

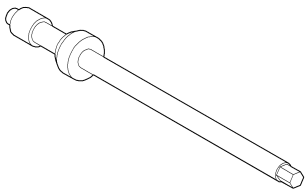
DCL-ID: 0000005896 - 002

Installation/removal tool



Part No.:	F6789889
Qty.: Used in:	1 6.6.2 Injector – Removal and installation (→ Page 120)

Milling cutter



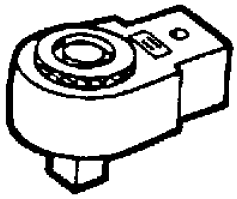
Part No.:	F30452739
Qty.: Used in:	1 6.6.2 Injector – Removal and installation (→ Page 120)

MTU test kit

5605892099/00

Part No.:	5605892099/00
Qty.: Used in:	1 6.13.3 Engine oil – Sample extraction and analysis (→ Page 143)
Qty.: Used in:	1 6.15.6 Engine coolant – Sample extraction and analysis (→ Page 154)

Ratchet adapter



Part No.:	F30027341
Qty.: Used in:	1 6.4.2 Valve clearance – Check and adjustment (→ Page 113)
Qty.: Used in:	1 6.13.1 Engine oil – Change (→ Page 140)

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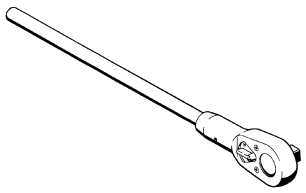
Ratchet with extension



Part No.:	F30006212
Qty.:	1
Used in:	6.1.1 Engine – Barring manually (→ Page 104)

Rigid endoscope

Part No.:	Y20097353
Qty.:	1
Used in:	6.2.1 Cylinder liner – Endoscopic examination (→ Page 107)

Steam jet cleaner

Part No.:	-
Qty.:	1
Used in:	3.11 Plant cleaning (→ Page 50)

Torque wrench, 0.5-5 Nm

Part No.:	0015384230
Qty.:	1
Used in:	6.6.2 Injector – Removal and installation (→ Page 120)

DCL-ID: 0000005896 - 002

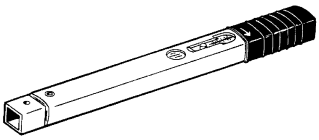
Torque wrench, 10-60 Nm

Part No.:	F30510423
Qty.:	1
Used in:	1.4 Crankshaft transport locking device (→ Page 8)

Torque wrench, 10-60 Nm

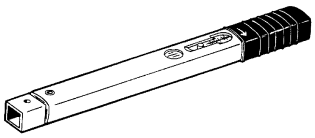
Part No.:	F30452769
Qty.:	1
Used in:	6.6.2 Injector – Removal and installation (→ Page 120)

Torque wrench, 40-200 Nm



Part No.:	F30027337
Qty.:	1
Used in:	6.13.1 Engine oil – Change (→ Page 140)

Torque wrench, 6-50 Nm



Part No.:	F30027336
Qty.:	1
Used in:	6.14.2 Centrifugal oil filter – Cleaning and filter sleeve replacement (→ Page 145)

DCL-ID: 0000005896 - 002

Torque wrench, 60-320 Nm

Part No.:	F30047446
Qty.:	1
Used in:	1.4 Crankshaft transport locking device (→ Page 8)

Torque wrench, 60-320 Nm

Part No.:	F30452768
Qty.:	1
Used in:	6.4.2 Valve clearance – Check and adjustment (→ Page 113)
Qty.:	1
Used in:	6.6.2 Injector – Removal and installation (→ Page 120)

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